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THE CONCEPT OF INTERNATIONALISM[1]

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To all men of good-will, the thought of peace on earth must occur, and to many through the centuries it has been a compelling preoccupation. At no time in the world's history can it have presented itself more forcibly than now when the war in Europe is in its final stage, and arrangements for an adequate peace settlement have become imminent. As an important part of the historian's task is to illuminate the present by explaining the past, it is both fitting and highly desirable to consider here the pertinent events of the past that bear on this most important question of a better world order, and thus aid, no matter how slightly, toward a better comprehension and solution of the problems involved.

In 1933 this section held a Symposium on Nationalism[2]; I feel that it is significant that to-day it seems desirable to contemplate the concept of internationalism. As your chairman, charged with the responsibility of addressing the section, I have ventured to go out of my own field to consider the subject—not claiming any special knowledge and even admitting to the scholar's sin of utilizing some secondary sources, but with an amateur's enthusiasm and a lively sense of the importance of an informed public's opinion, especially while the course of legislative and administrative action is being shaped. I was further spurred to learn what I could from a considerable "literature" on the subject, in spare moments spread over several months, by the recent appearance of Hans Kohn's book on "The Idea of Nationalism."[3] My surprise at his view that the idea of "nationalism" only began with the French Revolution was equalled by the discovery that a real concept of internationalism had cropped up not infrequently since the ancient Greeks and Hebrews, even though the word did not appear in dictionaries

[1] Vice-presidential address, Section L—History and Philosophy of Science, American Association for the Advancement of Science, Cleveland, Ohio, September 12, 1944.

[2] W. G. Leland, "Nationalism," Papers presented at the 1933 meeting of the American Association for the Advancement of Science.

[3] Hans Kohn, "The Idea of Nationalism," New York: Macmillan, 1944.

till the nineteenth century. [In Samuel Johnson's Dictionary (1755; 4 Ed. 1775), for instance, neither "nationalism" nor "internationalism" appears, though one of the definitions for "national" is given as "bigotted to one's own country."] This can be taken to indicate that there was no particular concern with these concepts at this time. Incidentally, "civilization" is defined by that great lexicographer only as "the legal act of rendering a criminal act civil"!

With your indulgence, I shall touch on some pertinent high spots in the time allowed. My remarks may be clearer if prefaced by a few definitions: "internationalism" I would like to use in the sense of "all human relations between nations cooperating in a mutually advantageous manner." But as this, strictly interpreted, would exclude some of what I want to consider, I shall turn to the inadequate dictionary definition of "the state or principle of international interests or intercourse." [Such internationalism, of course, has nothing to do with the belligerent communism of the three Internationales. Yet such is the influence of "sneer words" that the Ligue Internationale et Permanente de la Paix (1867) found it desirable after some years to change its name so as to avoid any undesirable confusion with the other organization.] By "universalism" I mean to indicate the idea of human unity, whether of religion, ethics, government or other activity, a *societas generis humani;* the *Ta-Tung,* or world brotherhood (lit., "great similarity") that Confucius hoped for. By "imperialism" is meant the concept of forcibly including as much of the world as possible under one government, whether under an absolute monarch such as Alexander, or under a more constitutional form of government; "nationalism" represents the condition arising among people effectively united which leads to protection and advancement of their common interests—nationalism is, thus, a complex idea, compatible with various forms of government and of combinations of races, religions and customs. It is nearest to, but not identical with, "patriotism." [Incidentally, "patriotism," in the sense of devotion to one's country, made its appearance in England about 1725, but was often used ironically.] Nationalism differs from what has been called "Étatism," as illustrated by the active condition of German nationalism after Napoleon, when there were many separate German states, compared to the France of Louis XIV, where there was one powerful state but little or no feeling of nationalism.

Having become once more impressed with the superior power of ideas over material strength, even in making war, we should not be surprised to learn that the two exemplars of this principle among the peoples of antiquity—the Hebrews and the Greeks—contributed basically toward the concept whose fluctuations I shall endeavor to trace. The Hebrews, though strongly national politically, as they had to be in order to survive between their very powerful neighbors, Egypt and Assyria, nevertheless traced Israel from the same ancestors as the rest of mankind. "Love thy neighbor as thyself" was an Old Testament commandment (Leviticus, 19:18) long before its repetition by Christ, even though later the Hebrews proudly divided the world into Jews and Gentiles. Their Messianism (Hebrew, Mashiah, the anointed one), which later became a nationalistic expression of longing for salvation, originally contemplated a universalistic divine King over all the earth. Amos's God was the God of all peoples, giving equal justice to all; Isaiah (19:25) invoked blessings on Egypt and Assyria as well as on Judea.

The Greeks, who early in their history (*ca.* 600 B.C.) acquired a consciousness of superiority and like the Jews regarded themselves as a chosen race, divided the known world into Greeks and Barbarians. They, however, developed the idea of universal humanism, which, both directly and through their conquerors, the Romans, has continued to influence future ages. (The Japanese, the only other significant example of an early developed nationalism, took the world's stage too late to have any effect on the modern growth of the idea of nationalism, and we may be allowed to hope that their nationalistic role on that stage is shortly to assume a minor position). Though the Greeks were none too successful in managing their political affairs, and city continued to fight city until even Aristotle and Plato regarded war as inevitable, they did recognize the advantages of confederation, and achieved it against the Persians when the need was great. In fact, their Amphictyonic Council, with its provision that no Amphictyon could annihilate another's city or cut off its water supply, can be taken as the first organized attempt to limit the barbarities of war.

It has been often, but truly, said that Rome in conquering Greece politically was overcome by Greece culturally. The Greek culture, Cicero's *humanitas,* which came to Rome especially through the Stoic philosophy with its world-state idea, and the later Hebrew earnestness and vision of the world filled with God's children, were combined by the Romans in a form based on a true universalistic concept. Virgil with a vision of this broader attitude wrote of Dido in a very different spirit than Cato's "delenda est Carthago." The Pax Romana, though interrupted by provincial wars and administered only by the upper classes, was the best obtained by mankind till the beneficent dominance of the British Empire. In the Roman Empire, there were no longer, as with the Greeks and Hebrews, but two classes: Romans, and the rest, fit only to be en-

slaved. Roman citizenship and its rights were extended ever more widely, so that those conquered in the later campaigns were even given the same rights as the conquerors. Some of Rome's best emperors came from conquered provinces. This enlightened attitude toward citizenship, marred though it was by excesses and the inherent cruelties which have only very gradually decreased with the progress of civilization, was further augmented by the uniformity and excellence of Roman law and shortly by the wide expansion of Christianity. Small wonder that this spiritual predecessor of internationalism exerted its great influence through the centuries.

Through the standstill of the Middle Ages, the cohesive effect of the Church and of Christianity maintained a greater unity among civilized peoples than in more individualistic later centuries. Internationalism it could not be, as nations in our sense of the word did not exist, but it was a universalism of religion and culture, even of a common language for the educated, which had advantages for those times. It also has a warning lesson for promoters of a true internationalism: The autocratic rule that the Church exerted as it gained temporal power is a good example, as Stawell[4] recalls, of the fact that all attempts at unity have been conceived as the imposition of uniformity, not as the tolerance of variety.

This sacerdotism did not exist unopposed. The Holy Roman Empire, whether under Charlemagne or Otto and his successors, constituted an imperialism which at its height under Frederick II, the great Hohenstaufen, strove for a Golden Age for the whole civilized world. Conceived as a benevolent imperium, and short lived at that, theoretically it should concern us less than the various proposals toward international organization, of which Rudolph Hirsch[5] has recently listed 36 up to the year 1789. Hirsch points out the noteworthy fact that these were the work not of visionaries but of "well-established" men, including 4 princes, 3 leading statesmen, 8 jurists and 5 philosophers of renown. The host of proposals in the nineteenth century is far too numerous even to mention here; many are included in ter Meulen's last 2 volumes.[6]

The earliest and a good example of these is the "Recovery of the Holy Land" (1306) by Pierre du Bois (Petrus de Bosco) of Coutances. (For an account of this and subsequent proposals see Lange's[7] scholarly work.) Recognizing that a single imperium was no longer feasible for Europe, he proposed a confederation between the powers, wherein all differences would be submitted to arbitration and the members would agree to punish any who refused to conform. To be sure, he had in mind a federation dominated by France; but like Sir Thomas More of a later age, and most of us to-day, he believed that his own people were best fitted for such leadership. It took an Erasmus to ask, "Who is there who does not think his own cause just?" Erasmus also had ideas of a League of Nations. He wisely observed: "A unified Empire would be best if we could have a Sovereign made in the image of God, but men being what they are, there is more safety among kings of moderate power united in a Christian League." He wanted an ideal *tranquilitas orbis Christiani,* rather than a self-seeking nationalism.

From France, at this period the most enlightened country in Europe, came a more far-reaching, truly international proposal. Emeric Crucé's "Nouveau Cynée" (1624) not only advocated a confederation to arbitrate difficulties and prevent wars, but included Asia, Africa and the Far East, even the terrible Turk, as well as the countries of Europe.

Perhaps the most important of these early plans for federations to enforce peace was that of the great Sully, minister to Henry IV of France. His Grand Dessein may, to be sure, have had chiefly in mind the reduction of Austria's power and the enhancement of Henry's, though he specifically warned against France attempting to become Empress of the West, which would be as harmful to her as to those subordinate to her. His République très Chrétienne de l'Europe was divided into 15 powers—6 hereditary monarchies, 5 elective monarchies and 4 republics (Switzerland, the Netherlands, Venice, Northern Italy). Various territories (such as Navarre, Sicily, Naples, Flanders, Alsace) were to be allocated as seemed best, quite in twentieth century fashion. As usual, arbitration was stipulated, also armies "sufficient to maintain continuous war against the Infidel." The horrors of war were to be limited and armies were to be "pacific," pay for their supplies, etc. Henry's assassination extinguished any chances for Sully's plan, which, besides, was not published until many years later, and probably in much altered form. In the light of the subsequent military history of Europe, it was at least a timely effort.

Almost contemporary with the publication of Sully's plan was the "de Jure Belli et Pacis" (1628) of Hugo Grotius, more important as the beginning of international law than for international organization. Grotius, however, stated his belief that "conferences should be established between Christian powers to settle disputes by the voice of those nations who are not themselves affected; and that methods should be

[4] F. M. Stawell, "The Growth of International Thought," New York: Holt, 1930.

[5] Rudolph Hirsch, "Plans for the Organization of International Peace, 1306–1789," A List of 36 Peace Proposals, New York: The New York Public Library, 1943.

[6] Jacob ter Meulen, "Der Gedanke der internationalen Organisation," 2 Vols. in 3, Haag: M. Nijhoff, 1917, 1929, 1940.

[7] Christian L. Lange, "L'Historie de l'Internationalisme jusqu'à la paix de Westphale (1648)," Christiana: Aschenhoug, and New York: J. P. Putnam, 1919.

found for compelling the parties to accept peace on reasonable terms."

William Penn, in his "Essay toward the Present and Future Peace of Europe" (1692), also maintained that countries should agree on a plan to avert war by establishing a sovereign assembly which should decide on all differences that could not be adjusted by the individual countries. He held, rather surprisingly for a Quaker, that any sovereignties that refused to submit their claims or to abide the judgment should be compelled to submission by all the other sovereignties, and damages be given to the suffering party. "Thus the sovereign princes remain as sovereign at home as ever and only have their power lessened abroad in hindering the great fish from eating the little one." None of these proposals, however, any more than the covenant of the League of Nations, met the crucial difficulty of providing a feasible mechanism capable of making even the most powerful aggressor nation abide by the agreement.

To those who believe that nationalism could only begin after Rousseau's insistence on the natural rights of man had led to the participation of all classes in the affairs of state, Rousseau's attitude toward internationalism becomes of considerable importance, though his direct contribution was small. Focussing on the freedom of the individual, he was only secondarily interested in forms of government. His nationalism was aimed at more personal liberty and justice, not at the elevation of the nation. (See his "Projet pour un Constitution pour la Corse.") A zealous pacifist, he favored universal military service as the least unjust form for the individual. He hoped that the same power that united a nation—the patriotic will of the people—might make a union of nations, based on the general will of their peoples. In Rousseau's League, from which secession was not to be permitted, he stressed the difference between bowing to a ruler's will and complying with the decision of a body of which one forms a component part: "Liberty is lost in the hands of a master; it is confirmed in the hands of associates." In his "Institutions politiques" (destroyed by the Comte d'Entraigues, but mentioned in "Emile") he favored a federation of the smaller states, joined by international treaty. He may be called a universalist, in the sense of the universal sovereignty of the people.

Together with the political idea of international cooperation, grew benevolent proposals for perpetual peace and the efforts of peace societies toward this end (Beales[8]). Especially in England were these stimulated by the philosopher, Jeremy Bentham, one of the first to use the term "internationalism." His "Plan for an Universal and Perpetual Peace (1787–9), called for the usual court of arbitration but also for limitation of armament and an international police force. It was an important influence on such liberalists as his pupil, James Mill, and, in this country, on Noah Worcester, William Ladd, the founder of the American Peace Society, Elihu Burritt and others. [It is probably useful to recall here that this was long before the days of propaganda and double-talk, and that the name represented the true goal of the society, not a cloak for some hidden, nefarious purpose.] If the soundest basis for a lasting peace is a sufficiently strong conviction on the part of the stronger nations that warfare is both individually and collectively inexpedient as well as uncivilized, then the permeation of such ideas, even though unassociated with conspicuous political events, assumes great importance. From this point of view, we may take legitimate satisfaction in the efforts of the sincere peace societies, in the various peace congresses (beginning with the London Congress of 1843), in such successful international achievements as the International Red Cross, the Hague Court of Arbitration, settlement of the Corfu and the Aland Island incidents, and in other by-products of the League of Nations, in our border with Canada, which has lasted for more than a century, unarmed, and in Norway's peaceful separation from Sweden.

Nationalism, being dependent on the concern of the people in their country's affairs, was well established in Great Britain by the eighteenth century, but was non-existent on the continent until implanted by the heady influence of the French Revolution. With the downfall of Napoleon's imperialism and the consequent widespread longing for peace, a situation curiously analogous to that of 1919 and 1944 arose, with its corresponding warnings. When representatives of all Europe met at Vienna in September, 1814, "to make a friendly settlement of European interests," it was hailed as the dawn of a new era of lasting international peace and concord. The four powers who had defeated Napoleon (Russia, Great Britain, Austria and Prussia) however, had already concluded a treaty (Chaumont, March 10, 1814) followed by a secret protocol which arranged that the Four Powers should first decide on moot questions and announce their decisions to France and Spain, the other members of the executive committee of the congress. The inevitable rifts quickly appeared in the solidarity of the four major powers and the scramble for territory was still continuing at Vienna when Napoleon returned from Elba. Though a Final Act was signed a few days before Waterloo, it was concluded so hurriedly that Castlereagh's progress toward a promise of collective

[8] A. C. F. Beales, "The Catholic Church and International Order," Penguin Books, New York, 1941; also, "The History of Peace," New York: The Dial Press, 1931.

war against transgressors came to naught. Thus the congress arranged little more than a patchwork of territorial shifts, that, however, provided a much needed breathing space for the peace of Europe. Napoleon having been finally eliminated, the Czar proclaimed (September 26, 1815) his Holy Alliance with Francis I of Austria and Frederick William III of Prussia. All the potentates of Europe, except the Sultan, were invited to sign, the Pope and Great Britain alone courteously declining; later even the American republics were approached. A general statement of principles of Christian union, rather than a definite treaty, the Holy Alliance produced no practical results toward a "universal union"; in fact, after the death of Alexander, it happened to become, more than once, an instrument of princely oppression of popular liberties. Nevertheless, as the Czar's good faith has been generally accepted, it must stand as a milestone in the progress of internationalism, and later inspired another Czar to call the first International Peace Congress at the Hague (1899).

When we consider the greatest achievement in the progress of internationalism—the League of Nations and Woodrow Wilson, the proponent of its idealistic features—we are still too close to the institution and to the man even to approximate a true evaluation. We can and should, however, recognize that this was the first internationalistic proposal actually to be put into effect, and that it was able to survive as an international force for almost a generation. In the opening deliberations, Léon Bourgeois may have been tiresome and certainly was unsuccessful, but with equal certainty he was prophetically correct when he asserted: "If we are to have a League with security for all, sacrifices will have to be made, traditions and long accustomed rights abandoned. But how insignificant is this loss of independent action when you contrast it with the menace that will hang over us all if the League is not established with force behind it?" Are we again about to neglect this warning? During the twenty-five years of its activities the League not only functioned successfully on an international basis in many ways but it also survived a number of political crises, even though of secondary importance. If it had had our own country as a full member, and had been able to find an acceptable formula for enforcing its decisions, who can tell whether it might not have survived its critical period. By gradually correcting its defects, it might have eventually produced a workable system as superior to the original instrument as our Constitution was to our earlier Articles of Confederation. And we should not dismiss the comparison as irrelevant; because the difficulties and differences among the American colonies of economics and transportation, diversified interests, creeds, customs and racial strains, were at least partly comparable to those to be faced by international organizers to-day. The American Union had its Gethsemane, but no one to-day can reasonably visualize its break-up. Now again the advantages of whole-hearted cooperation have been forcibly impressed on the United Nations by their common peril to a degree that must be obvious to all. To paraphrase Burke: "The question with us is not whether you have a right to render the peoples of the world revenged but unsecure, but whether it is your interest to make them contented and secure." We may at least hope that the next peacetime attempt at some sort of International Federation will, like the American Union, also be successful. An abundant good-will, a better social, economic and political order, and a non-partisan force adequate to protect that order—a difficult but by no means impossible combination—these are needful to produce the results for which the world longs. And we must not forget Woodrow Wilson's reply to the Pope during the last war: "No settlement which contravenes the principles of eternal justice will be a permanent one." Agreement is not difficult on the need for force, the crucial difficulty was and is attainment of a satisfactory mechanism for applying this force. Combined control by the four great powers may perhaps be necessary for our immediate postwar period of punishments and adjustments; but I believe, with many others, that for a lasting peace we shall have to turn to some sort of World Parliament, with such "power to act" that even the most powerful will not act against it.[9] Its voting powers, to be sure, if reasonably distributed among the nations, must recognize the greater responsibility of the strongest nations, but not to the extent of enabling one or two to block the whole procedure.

The objection may be raised that efficient international arrangements must await better economic adjustments for the backward races (which still add up numerically to more than one half of the world's population). This objection can be at least partially met by the analogy of the Declaration of Independence's assertion that all men are born free and equal at a time when slavery flourished in this country and many of the signers were slave holders. The plan was established, nevertheless, and the elimination of slavery followed soon after, undoubtedly helped by this very statement.

Just as in prehistoric times, the cave family found

[9] The march of world events has been so rapid that even the few months that have elapsed since this address was given have made this statement seem out of date. If, however, we find ourselves burdened with a new balance of power or controlled spheres of influence, we must regretfully accept this indication, that the civilized world's collective intelligence has not yet reached the level of recognizing the inexpediency of such a narrow interpretation of self-interest.

it expedient to join forces with those in the neighboring cave, and thus eventually progress as far as tribes, which in turn combined into governments of cities or states, and thus to nations, which through centuries developed into such as those we know to-day, so circumstances seem to make it inevitable that, in time still larger groups will combine, eventually, to embrace the world in one international order. Then, indeed, the lady author may say "I accept the Universe," and a new Carlyle reply "By Gad! You'd better!"

Not that, focussing on the logical, and as a matter of fact the inevitable, political economy of the future, we should neglect the contributions to world progress that have been made by the present age of nationalism. One has but to compare it with the several attempts at universalism that preceded it, whether in the form of autocratic imperialism, or the nebulous universalism of the Middle Ages (founded on religion and tradition). Nationalism—whether based on Decatur's blind loyalty, "My country, may she always be right, but my country right or wrong," or on Franklin's wise expediency, "We must all hang together, if we don't want to hang separately," or on Nathan Hale's pure devotion, "I regret that I have only one life to give for my country"—nationalism has been also an inevitable state in the progress of civilization. It is a complex unity, "A state of mind corresponding to a political fact" (I. Zangwill) so dependent on the development of an intelligent, participating population and on good means of communications between large, even heterogeneous groups, that even the name wasn't needed or coined till comparatively recent times.

It is an integration that has served a useful and important purpose. Overcoming the handicaps of mixed races, religions, cultures, aspirations and economic opportunities, it tends to protect and increase the liberty of its country's citizens, ennobling the existence of all social levels and enriching culture by its processes of differentiation. It promotes the prosperity of the nation, vitalizing its activities and organizing development of sparse and backward areas, and secures for its government the majesty of true authority.

It is, however, when the defects of these qualities outweigh the good points in this or that unbalanced or unfortunate nation, that nationalism may become a potent contributor to world catastrophe, distorting patriotism into chauvinistic arrogance and setting barriers that tend toward obsolete isolationism. Then are we forced, willy-nilly, to look for higher forms of political integration. In Kohn's words: "Once it increased individual liberty and happiness, now it undermines them and subjects them to the exigencies of its continued existence, which seems no longer justified. Once it was a great force of life, spurring on the evolution of mankind; now it may become a dead weight upon the march of humanity." Though this may seem to you too sweeping a generalization, as it does to me, yet we must accept at least that a distorted nationalism has had just this effect more than once, and apparently with increasing frequency in the twentieth century. In Nurse Cavell's inspired words, "Patriotism is not enough."

Not that nationalism should be thrown overboard. The smoothed curve of human progress rises very slowly, and doubtless future generations will long continue to profit under a temperate, adaptable nationalistic state. Furthermore, we must realize that the nationalistic concept, not pushed to an extreme, is compatible with a rational internationalism. In fact, it is this very truth which, in my opinion, is our main hope for the immediate future of our civilization.

(Here, I'd like to digress for a moment to express my impatience with those who threaten that another global war would destroy civilization. Just as I also can not abide those stupid clichés: "Human nature never changes," as if that should block all attempts at social progress, and "We've always had wars and we're always going to," as if a surgeon would say in a case of doubtful cancer, "He's never had cancer, so this can't be one." As to the destruction of civilization, it is perhaps conceivable that the civilization of the Roman era might have been destroyed by barbarian hordes, though even here we must recall the aphorism of Voltaire, one of the wisest of historians: "Men commit a stupendous number of unjust acts in the fury of their passions, as they lose their reason in drunkenness; but when the drunkenness has passed, reason returns, and that is in my opinion the only cause which makes society endure." To me, it is quite inconceivable that in the present state of civilization's control of this world, it could be so damaged by any agent of this world that it would be beyond redemption after the drunkenness had passed.)

Thus, by way of summary, I have tried to trace from the universalistic religious ideology of the Hebrews and Christianity and the cultural humanism of the Greeks the elements which through the centuries have influenced internationalistic ideas and activities. With the depolitization of religion and the decline of absolute monarchies—both forces, to be sure, possessing elements useful for the progress of civilization—and with the rise of the people's share in government, nationalism grew to be a dominant factor through the nineteenth century. This, too, was for the most part a desirable development, at a time when man's control over nature had grown to such an extent that wider contacts over the earth's surface became inevitable and larger political units resulted. No longer restricted to a common race, language, tradition or economy, but

united only by a complex, yet zealous patriotism, nationalism has more and more tended to exceed the satisfying of political necessities. To-day, the evils of an exaggerated and perverted nationalism in various quarters, linked with the ever-increasing obliteration of world barriers and distances, appear to be hastening the completion of a cycle back to universalism. We have seen that internationalistic proposals have been made with increasing frequency over six centuries, but none put on actual trial till the League of Nations. We see that benevolent and logical proposals have not been enough, even when backed by high authority. However, an ever-increasing informed public opinion has already made its influence felt. On the other hand, the industrial age and man's greater control over the forces of nature have so charged the situation with world danger that unless it is efficiently met, modern civilization would appear to be doomed to the worst setback in its entire course. It would seem that a lasting solution of the international problem will only be found in the achievement of a plan based on justice to all and containing adequate provision for restraining the transgressor. This, then, is indeed a critical period of world's progress, but one which, wisely comprehended and handled, may so combine a rational nationalism with the internationalism of my original definition that the coming one hundred years may register the steepest curve yet recorded of man's upward progress.

I am near the end of my address, yet you will notice that I've not even mentioned the internationalism of science, of religion, of art, of commerce, of economic trends, in most of which we may take just pride. Every scientist knows that the scientist has culled his information from whatever land can provide it ever since there has been a science; and that, in normal times, his discovery as soon as published is broadcast throughout the scientific world. We can note with satisfaction that even to-day, astronomy pursues its customary international course, and a discovery, though perhaps made by a citizen of a warring country, is telegraphed to a neutral and thence to all the world. The ambitious student, if he has the necessary means and wisdom, goes to whatever center can give him the best education, regardless of country, and the historian of science as readily gives credit to a German as to a Frenchman, Swede, Britisher or American. Internationalism in art and literature has been accepted as matter of course for centuries. Masterpieces are recognized and eagerly collected regardless of their country of origin; art students flock to the center where they expect to find the best training regardless of its location, and pride in one's own country—a desirable form of nationalism—is but little apparent in artistic matters.[10] Commerce existed between nations long before nations existed—if you will pardon an Irishism—hampered at times, to be sure, when ideas of self-preservation raised tariff barriers; though I believe that economists generally accept the theoretical superiority of free trade over protective tariffs.

To-day you can talk with the ends of the earth more quickly than our Revolutionary great-grandfathers could get in touch with a neighboring village; and Jules Verne's Phineas Finn could now go round the world in nearer eighty hours than eighty days. Just as we are so much nearer to our neighbors, so also life's tempo increases, for bad as well as for good. The world's ability to produce, distribute and communicate has been vastly increased; but in its political arrangements it has sadly lagged. International comprehension, also, is conspicuously inadequate. As we have no way of estimating the intellectual capacity of the peoples of the world, how arrogant to assume a permanent inequality of races, with our own of course at the top! Thus, provocations and wars can and do arise more frequently and ever more devastatingly. The more imperative has it become, therefore, that the nations of the world set up an adequate framework, backed by the same sort of compelling force that each nation requires for preservation of its internal peace, to repress or chastise the international law breaker. We have now seen the catastrophic effects of this political lag twice in one generation. It would seem but common sense then, at no matter what cost, for the civilized world to make a third and worse catastrophe impossible. May God give those in authority the wisdom to erect such a just international structure that the world may shortly attain to a lasting peace!

THE WHITE DWARFS

By Professor W. J. LUYTEN
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THE discovery by Adams in 1915 that the faint companion to Sirius, the brightest star in the sky, was *white* caused a minor revolution in astronomical and physical thinking. In a sense this faint star had been discovered before it had been seen, for its existence had been proved by Auwers from the gravitational effect it produced in the motion of Sirius itself. By 1915 the orbits in which Sirius and this faint com-

[10] W. G. Leland, "The Internationalism of American Scholarship," Providence, R. I.: Brown University, 1940.

panion revolved around their center of mass were accurately known; likewise we knew the distance of the system from us, and thus from the apparent brightness could calculate the real, intrinsic luminosity. In this way it was found that the companion had a mass only slightly less than that of the sun, but a luminosity 400 times smaller. Taken by themselves neither of these figures appeared out of ordinary, but when Adams found that the star was much whiter than the sun, with a surface temperature of some 8,000° K, the situation took on an entirely different aspect. From the temperature we could calculate the surface brightness and found that the star gave out about three times as much light as the sun does per square inch and since the total luminosity is 400 times smaller than that of the sun, it follows that the surface of this faint companion must be 1,200 times smaller than that of the sun, and hence its volume 42,000 times smaller, or smaller than that of the planet Uranus. Yet in this space is concentrated virtually as much matter as there is in the sun, leading to a density 50,000 times that of water.

At first sight it was unbelievable, and it appeared that an impasse had been reached especially when a faint star in the constellation Eridanus, found white the year before, and still another similar star found in 1917 joined to make up the first three "White Dwarfs." The answer to the riddle came a few years later when Eddington showed that these stars are largely composed of or contain central cores of "degenerate matter" raised to such a high temperature that not merely the outer shells of electrons have been removed by ionization, but that in many cases all electrons have been stripped off and the atoms are reduced to their bare nuclei. In the words of Oliver Lodge, under ordinary circumstances when the atomic nuclei are surrounded by shell after shell of fast-moving electrons, matter can be compared to flies buzzing in a cathedral. But when the temperature is raised to several hundred million degrees the electrons become ionized away—the cathedral walls collapse and all there is left are the flies. And, naturally, one can pack a good many more flies than cathedrals in a cubic mile.

A great deal more theoretical work has been done on the physical nature of these stars by Eddington, Milne, Chandrasekhar and others, as a result of which there is now fair agreement as to the internal constitution of these stars or rather, to be on the safe side, as to what should be the internal constitution of the white dwarfs; many astronomers even feel that we understand the structure of these freak stars better than that of ordinary stars.

Right at the beginning came Eddington's startling prediction that, because of the high density and the consequent high value of surface gravity of these stars, the light rays leaving their surface should, if Einstein's relativity is correct, be slowed down in their vibrations. Thus spectral lines produced by any given chemical element should be shifted toward the red as compared to the same lines produced by sources on the earth. The verification of this prediction at Mt. Wilson by observations on the companion of Sirius killed two birds with one stone, since it not only proved that Eddington's picture of the structure of the white dwarfs was correct but also that Einstein was right.

In the present article I should like to stress more the observational aspect of the situation, since this is one in which my own work has been primarily concerned. When I began in 1921 to observe the spectra of stars of low luminosity only one star out of one hundred observed proved to be a white dwarf—and even that one was not generally so recognized until twenty years later. It was evident from this that the majority of white dwarfs must be found among the very faint stars. To get their spectra was not only beyond reach of the then existing equipment, but our surveys of the sky for such stars were as yet very incomplete.

In order to remedy this situation I undertook first a survey of the entire southern hemisphere as well as of large parts of the northern hemisphere in a search for stars of low luminosity. Planned, and initiated in 1923 while I was at Harvard, it was continued under the auspices of the Guggenheim Foundation during 1928–30 while at the South African station of the Harvard Observatory. The series of photographic plates obtained there were examined after I went to Minnesota in 1931, and this survey was completed in 1936.

In the course of this survey some 30 million stars were examined and from among them some 100,000 were selected because of a conspicuous displacement across the sky, a "proper motion." This, of course, is an angular displacement, and, other things being equal, a swift angular displacement must mean that the star in question is comparatively near, and a star which is both near and very faint in appearance must be a star of low luminosity. After this first screening test, the search was narrowed down still further by selecting from among the 100,000 stars with appreciable motion, the 3,000 stars of *largest* angular motion. These 3,000 stars constitute the most likely selection of really intrinsically faint stars from among the entire 30,000,000. Finally, it is evident also that since white dwarfs are to be found among stars of low luminosity this final list of 3,000 faint stars with large proper motion constituted by far the richest potential source of white dwarfs.

It was to be expected that the vast majority of them would be ordinary red dwarfs with a surface

temperature around 3,000° K and the problem was to find those that were not red but white. To distinguish between the two kinds it would be necessary only to compare two photographs, one taken in blue light, the other through a red filter: as compared with the average of the other stars shown on the plates the red dwarfs would be much brighter on the red plates, the white dwarfs much brighter on the blue plates. For some years I had no success in interesting other observatories in a program of observations of this nature. Since 1939, however, I have been able, through the kind permission and cooperation of Dr. E. F. Carpenter, to use the 36-inch reflector of the Steward Observatory of the University of Arizona for a few weeks each year. Since 1942 Dr. P. D. Jose at Tucson has collaborated on this program, while in addition Dr. Martin Dartayet at the National Observatory at Cordoba, Argentina, has collaborated in obtaining plates for stars too far south to be observed from Arizona.

In the meantime the spectra of many faint stars of large proper motion discovered by Wolf or Ross were determined at observatories possessing powerful spectroscopic equipment, and a number of white dwarfs were identified in this way, mainly by Kuiper.

Until recently this line of attack, *viz.*, that of first discovering the stars with large motions—with or without subsequent measurement of their distances, and hence of their luminosities—and secondly determining the star's color or spectral class seemed to provide the only systematic and fruitful approach to the problem. Within the past few years, however, a different and novel method has been developed by Zwicky at the California Institute of Technology. His method is based upon the well-known fact that the overwhelming majority of white stars are (a) much more luminous than the sun, and (b) largely concentrated near the central plane of our Milky Way System. Any star which is both white and faint in appearance must therefore be extremely distant if it is to be a normal, luminous white star. Zwicky therefore simply searched for white stars in regions of the sky where very distant stars are not visible either because there aren't any, as in the direction toward the poles of the Milky Way or in areas where a dense obscuring cloud is known to hide all distant stars from view. Any faint white star appearing in either region must then be very close to us; in other words, it must be a white dwarf.

In all these various ways a total number of 70 white dwarfs have now been discovered; for 38 of these the proper motions were found at Minnesota by the writer, and for 39 the whiteness of the star was first determined by the writer alone or with his collaborators.

Among those for which spectra are known the largest number are similar to the prototype o_2 Eridani B, *i.e.*, their spectra somewhat resemble those of Sirius and Vega. Some white dwarfs resemble the bluer B stars in their spectra, still others, and still fewer the yellower F and G type. Some show virtually no absorption lines at all, and their spectrum must be classified as "continuous"; for these stars the wave-length intensity curves may correspond to temperatures ranging all the way from the hottest O type to the much cooler K type.

The coolest white dwarf of them all is, perhaps, represented by the extremely faint companion to BD + 4 : 4048 discovered by Van Biesbroeck. The luminosity of this star is less than one half-millionth of that of the sun, but its color corresponds to that of a star of spectral class M, whose luminosity averages several thousand times greater. Perhaps, therefore, this very faint star, intrinsically the faintest star known, stands in the same relation to an ordinary M dwarf as a typical white dwarf compares to Sirius: it may begin to approach the *ne plus ultra* in smallness and degeneracy, the Black Dwarf.

Because of the peculiarities of their spectra it has long been recognized that these stars can not be classified in the same way as ordinary stars; one proposal is to give their spectra the same capital letter as that to which they roughly correspond but also the prefix "w," thus wA, wF, wG, etc. It seems to me that this is not only redundant but even illogical. Surely the significant thing about a white dwarf thus classified as wA is not that it is white—the letter A tells us that—but that it is an extreme dwarf. Since for many years we have designated ordinary dwarfs by the prefix "d" it would seem logical to extend that practice and classify all white dwarf spectra by the capital letter "D"—which possesses the double advantage of indicating "dwarf" as well as "degeneracy," thus describing the physical state of matter as well. Those stars whose spectra are devoid of lines could then be described by DC followed by a number expressing the surface temperature in thousands of degrees. Other, more normal stars could be described by DA, DF, DG, etc.

Enough white dwarfs are now known and enough distances have been determined for them to enable us to make some simple statistical analyses. First of all, it appears that those with a spectrum of the DA type are the most numerous and that these, on the average, are about 700 times less luminous than our sun, intrinsically; those with DB or DF and DG spectra are apparently rarer in space and both appear to be somewhat less luminous, averaging perhaps less than one thousandth of the sun's luminosity. Still fainter seem to be those whose spectra, while continuous, indicate temperatures equal to, or lower than that of the sun, and the faintest of all white dwarfs appears to

be the star L 97–12, with a luminosity 20,000 times smaller than that of the sun, unless, of course, Van Biesbroeck's star should turn out to be a white dwarf.

Whether these several groups are isolated from each other or whether all the white dwarfs are related in one continuous sequence it is too early to say. In so far as their motions are concerned, the white dwarfs appear to resemble the stars of high velocity, but this was to be expected, since the majority of them were found among the stars of large angular motion.

In their distribution over the sky the white dwarfs do not show any pronounced idiosyncrasies except, perhaps, for a slight concentration near the south pole of the galaxy, but this may be only apparent, or accidental.

Among the most interesting white dwarfs are those which form part of binary systems; ultimately these will become very important, for it is only from the orbital motions of such double stars that we can really determine that crucial quantity—the mass of a star. Sirius is, of course, the classical example and in this case both the orbit of the faint white dwarf around the normal primary and the radio of the masses are accurately known, yielding the only really accurate value for the mass of a white dwarf we possess. In the case of Procyon the mass and luminosity of the faint companion are known, but neither its color nor its spectrum have been observed, and while we suspect it to be a white dwarf because of its much larger mass than expected from its luminosity, we can not be sure. The faint companion to the giant variable star Mira Ceti may be a white dwarf, but if so, it appears to be considerably more luminous than any others now known. One of the components of o_2 Eridani is unquestionably a white dwarf, and while at present neither the orbit nor the mass ratio are accurately known we expect to clear up both these deficiencies in a few decades. In addition to these four systems seven other double stars are known to contain one white dwarf, but in most of these the two components are so far apart and hence the orbital motions so slow that certainly decades and perhaps centuries must elapse before we can accurately determine their orbits and mass-ratios.

To all these may now be added the double white dwarf found by the present writer. To date it is the only double star of which both components are white dwarfs. Situated in the constellation Antlia, nearly 50 degrees due south of the bright star Regulus in Leo, it was first found on Harvard plates to possess the large proper motion of 0".37 annually. Further observations I made at Tucson then showed the star to be both white and double; other plates taken by Baade at Mt. Wilson and Van Biesbroeck at MacDonald, and kindly sent to Minnesota for examination, have led to the following conclusions:

The two components are very nearly equal in brightness, and probably 1,600 times less luminous than the sun; they are both white or blue in color, and would appear to have a diameter smaller than that of the earth. If they are of normal mass, about equal to that of the sun, their density would be of the order of one million times that of water, or about 25 tons per cubic inch. They appear separated by about 4 seconds of arc, which, if our guess as to their distance is correct, would mean about fifty times as far apart as the sun and the earth. Insufficient time has elapsed since the discovery to enable us to do more than estimate the period of orbital revolution at around 250 years. Within the next ten years it should be possible to determine this quantity, as well as the star's distance from us with much precision: from these we shall then obtain the combined mass of the system. In all other binaries involving a white dwarf component the ratio of the masses would also be necessary —and to determine this even approximately would take much longer than a decade—because in all other systems the two components are very dissimilar. In the present binary, however, the two components appear to be so nearly identical in color and in luminosity that one may safely assume that their masses are also virtually equal, and this new double white dwarf therefore seems destined to play an important role in our search for knowledge concerning the white dwarfs.

SCIENTIFIC EVENTS

THE NEW YORK BOTANICAL GARDEN

POST-WAR plans for the greater development of the New York Botanical Garden, in conformity with the post-war plans of the City of New York, were outlined by Dr. William J. Robbins, director, in presenting his annual report on January 16 to members of the Corporation and the Board of Managers. These plans, he pointed out, have occupied much of the time of the staff members and officials of the garden during the past year, and their consummation will provide the means for carrying on more work of world-wide scope in botanical research, as well as providing for the people of New York ornamental displays and recreational and educational facilities in the field of botany and gardening. In the preparation of these plans, the garden has had the cooperation of the Park Department of the City of New York, of Major Gilmore Clarke and of the architectural firms of Aymar Embury II and Skidmore, Owings and Merrill.

The recent rehabilitation of the growing greenhouses

which were partially destroyed by fire late in 1942 was one of the major events of the year, because it means the gradual resumption, starting within a few weeks, of the special floral displays which had been a leading attraction in the main conservatories every winter for a number of years. These displays, in a normal season when the plants could be grown and the people could reach the garden easily, have brought from five to fifteen thousand visitors to the conservatories on a single Sunday. The greenhouse which was damaged was the one in which the display material was being propagated and grown, and since the fire there has been no other place on the grounds where this extensive work could be carried on.

The opening of the new building will also enable the garden to re-establish experimental work and to resume the growing of a large collection of plants of scientific and economic value.

Explorations have been carried out in the tropical regions of the Americas during the year just closed. Dr. Bassett Maguire, curator, returned on November 1 from an eight months' exploring expedition in British Guiana and Surinam. E. J. Alexander, assistant curator, is now directing a six months' expedition for botanical and horticultural material in little known parts of southern Mexico. Dr. W. H. Camp, assistant curator, who is on leave of absence, is collecting specimens of plants in the mountains of Ecuador, while on a Government project in search of cinchona trees for quinine production.

THE ANNUAL REPORT OF THE COMMONWEALTH FUND

IT is stated in the annual report by Barry C. Smith, general director of the Commonwealth Fund, that in the year ending September 30, 1944, the fund appropriated $1,254,988, chiefly for the relief of needs created or revealed by the war, for the long-range encouragement of health services, and for basic research and planning designed to improve health services after the war.

He reports that "In the field of health services conspicuous changes concerning medical practice seem to be in the making. These, although their exact form can not be foreseen, look primarily to the wider and more equable distribution of medical care. If they are judiciously planned and intelligently administered, they may also help to better the quality of medical care. The fund has contributed toward the exploration of these questions through a subvention (voted in 1943) to the New York Academy of Medicine for a study of medicine and the changing order; during the coming year it will publish a series of monographs growing out of this study. The fund will continue to experiment, as it has done for years, with ways and means of bettering the quality of medical care.

"In medical education—obviously a dominant factor in setting the level of medical practice—the situation is confused by the violent adjustments of the accelerated program. Many medical educators feel the need for new teaching methods, new cross-connections between departments in the medical school, new ways of retraining men already in practice. The fund hopes to share in furthering such changes, some of which, on a small scale, it has already helped to initiate.

"In medical research the future is unpredictable. What is predictable is that the growing preoccupation of investigators with underlying physiological patterns—the patterns that may hold the key to understanding and perhaps control of the chronic diseases of middle age and senescence—will continue for many years to justify the wholehearted support of many inquiries that seem, on their face, recondite and even 'impractical.' It is clear, too, that there may be a strong trend toward coordinated research, so strikingly vindicated in the handling of some problems of war medicine and so hard to reconcile with long-established habits in scientific work."

GRANTS OF THE COMMITTEE ON SCIENTIFIC RESEARCH OF THE AMERICAN MEDICAL ASSOCIATION

THE following grants have been made by the Committee on Scientific Research of the American Medical Association:

George Ulett, University of Oregon Medical School, electroencephalograms in experimental focal brain lesions.

Hans Popper, Cook County Hospital, Chicago, liver structure in relation to function tests.

Wilbur Thomas, Bowman Gray School of Medicine, Winston-Salem, N. C., experimental cardiac rupture.

A. M. Lassek, Medical College of the State of South Carolina, effect of paralysis on human pyramidal system.

Archie R. Tunturi, University of Oregon Medical School, acoustic area in cortex of the dog.

Leo Hardt, Loyola University School of Medicine, Chicago, new gastroscope.

David Sandweiss and Thomas L. Patterson, Wayne University College of Medicine, Detroit, relation of the endocrine glands to urogastrone.

Israel Davidsohn, Mount Sinai Hospital, Chicago, problems of Rh factor.

Frederick M. Allen, New York, studies on refrigeration surgery and treatment.

J. LeRoy Conel, Harvard Medical School, postnatal development of the human cerebral cortex.

Herbert S. Kupperman, University of Georgia, pregnancy test.

Theodor E. Bratrud, University of Minnesota Medical School, colored illustrations for article on congenital adrenal hyperplasia.

Wilhelm Raab, University of Vermont College of Medi-

cine, protective effect of thiouracil against the toxic cardiovascular action of epinephrine and sympathin.

W. E. Garrey, Vanderbilt University School of Medicine, innervation of the heart of vertebrates.

Helen Ingleby, Woman's Medical College of Pennsylvania, problems of cystic disease and carcinoma of the breast.

O. Boyd Houchin, Loyola University School of Medicine, Chicago, vitamin E deficiency in relation to cardiac function.

Rachmiel Levine, Michael Reese Hospital, Chicago, secretion and metabolism of progesterone in threatened abortion.

Daniel J. Glomset, Des Moines, Iowa, cardiac conduction.

H. M. Weaver, Wayne University College of Medicine, Detroit, production and treatment of alloxan diabetic coma in rats.

GRANTS OF THE ELLA SACHS PLOTZ FOUNDATION

THE twenty-first annual report for 1944 of the Ella Sachs Plotz Foundation for the Advancement of Scientific Education has been made public. This includes a list of those who received grants during the year together with the subjects of their research.

The following is an outline of the policy that has been adopted in making these awards.

Researches are favored that are directed towards the solution of problems in medicine and surgery or in branches of science bearing on medicine and surgery.

As a rule, preference is given to researches on a single problem or on closely allied problems; it is hoped that investigators in this and in other countries may be found, whose work on similar or related problems may be assisted so that more rapid progress may be made possible.

Grants may be used for the purchase of apparatus and supplies that are needed for special investigations, and for the payment of unusual expenses incident to such investigations, including technical assistance, but not for providing apparatus or materials which are ordinarily a part of laboratory equipment. Stipends for the support of investigators will be granted only under exceptional circumstances.

In the past few years the policy outlined in paragraph 2 has been neglected and grants will be given in the sciences closely related to medicine without reference to special fields. The maximum size of grants is usually less than $500.

Applications for grants to be held during the year 1945–46 must be in the hands of the executive committee before April, 1945. They should be sent to Dr. Joseph C. Aub, The Massachusetts General Hospital, Fruit Street, Boston 14. There are no formal application blanks but letters asking for aid must state definitely the qualifications of the investigator, give an accurate description of the research, the size of the grant requested and the specific use of the money to be expended. In their requests for aid applicants should state whether or not they have approached other foundations for financial assistance. It is highly desirable to include letters of recommendation from the directors of the departments in which the work is to be done. Only applications complying with the above conditions will be considered.

Members of the executive committee are Drs. George B. Wislocki, *Chairman*, Charles Janeway, A. Baird Hastings, Harry Plotz, Ernest Sachs, Paul J. Sachs and Joseph C. Aub, *Secretary*.

THE MEETING OF THE BOARD OF REGENTS OF THE SMITHSONIAN INSTITUTION

AT a meeting of the Board of Regents of the Smithsonian Institution, held on January 12, 1945, as already reported in SCIENCE, Dr. Alexander Wetmore was elected to the post of secretary. This place was left vacant by the resignation on June 30, 1944, of Dr. Charles G. Abbot, who asked to be relieved of administrative duties in order that he might devote himself to his researches. Dr. Wetmore, who has served as assistant secretary of the institution since 1925, has accepted the post with the understanding that at some later time he will be permitted to return to research work.

Among the regents present at the meeting were Chief Justice Harlan F. Stone, chancellor of the board; Representative Clarence Cannon, and citizen regents Harvey N. Davis, Arthur H. Compton, Vannevar Bush and Frederic C. Walcott.

Reports presented covered the activities of the institution during another year of war. Much of its normal program of research and exploration continued in abeyance, with the scientific staff devoting much time to technical information needed by the Army and Navy and other war agencies. The questions coming to the institution cover a wide variety of topics, including native peoples; geography; disease-bearing insects; parasites; poisonous and edible plants, animals and fishes; shipworms; properties of foreign woods; and many others. In many instances the requests involve extensive research.

Seven more papers were issued in the series of "Smithsonian War Background Studies." These deal with Alaska, the East Indies, Micronesia and Melanesia, Burma, India, French Indo-China and China. Special editions of several of these papers have been used by the Army and Navy in training and orientation work.

In the field of Latin American cooperation, the "Handbook of South American Indians," a coopera-

tive project with the State Department, was well advanced, with two volumes already in type and the third near completion. Half the authors represented in this unique work are anthropologists of the other American republics. Dr. Julian H. Steward, editor of the handbook, is also director of the Institute of Social Anthropology, established for training in anthropological teaching and research. This work is a part of the program of the Interdepartmental Committee for Cooperation with the American Republics.

New accessions to the collections of the National Museum numbered 239,640 for the year. The number of visitors, 1,532,765, of whom approximately 40 per cent. were men and women in uniform, showed an increase over the previous year.

At the Freer Gallery of Art, much of the time of the staff was occupied in examining and translating Japanese documents for the war agencies, and in compiling a glossary of geographical and topographical terms for war purposes.

The three field observing stations of the Astrophysical Observatory were kept in operation, in spite of manpower difficulties. It is considered particularly important to maintain a continuous record of the solar constant of radiation so that there may be no break in these observations.

SCIENTIFIC NOTES AND NEWS

AMONG New Year Honors conferred by the King of England are: *The Order of Merit* on Dr. Alfred North Whitehead, F.R.S., from 1942 to 1937, when he retired with the title emeritus, professor of philosophy at Harvard University; the title of *Baronet* on Sir Alfred Webb Johnson, president of the Royal College of Surgeons; of *Knight Bachelor* on Dr. Edward Battersby Bailey, F.R.S., director of the Geological Survey of Great Britain, Department of Scientific and Industrial Research; on James Chadwick, F.R.S., professor of physics at the University of Liverpool, for services to the Department of Scientific and Industrial Research; on Professor Edmund Taylor Whittaker, F.R.S., professor of mathematics at the University of Edinburgh, lately president of the Royal Society of Edinburgh, and on Charles William Blyth Normand, Meteorological Department of India, lately director-general of the observatories of India.

DR. ALEXANDER WETMORE, secretary of the Smithsonian Institution, has been elected a fellow of the California Academy of Sciences.

BRIGADIER GENERAL JAMES S. SIMMONS, U.S.A., chief of the Preventive Medicine Service, was chosen at the Saint Louis meeting president elect of the American Society of Tropical Medicine.

OFFICERS of the Association for Research in Nervous and Mental Disease, elected for the coming year at the annual meeting held in New York on December 16, are: *President,* William G. Lennox; *Vice-presidents,* H. Houston Merritt and Wilder Penfield, and *Secretary-Treasurer,* Thomas E. Bamford, Jr. It was voted to center the program for the meeting a year hence on the subject of epilepsy and convulsive disorders.

THE following officers of the New York City Branch of the Society of American Bacteriologists have been elected for 1945: *President,* Dr. Gustav I. Steffen, Bureau of Laboratories, Department of Health, New York City; *Vice-president,* Dr. Ivan C. Hall, New York Medical College; *Secretary-Treasurer,* Dr. John E. Blair, Hospital for Joint Diseases; *Councilor* to the Society of American Bacteriologists, Mrs. Mary B. Horton, Sheffield Farms Company, Inc.

DR. CYRIL D. DARLINGTON, director of the John Innes Horticultural Institution, has been elected president of the British Genetical Society.

DR. A. E. JOHNS, McMaster University, Hamilton, Ontario, has been elected president of the Royal Astronomical Society of Canada. He succeeds Dr. A. Vibert Douglas, dean of women at Queen's University, Kingston, who has retired after serving for two years. H. Boyd Bryden, Victoria, B. C., and Dr. J. W. Campbell, University of Alberta, Edmonton, have been elected vice-presidents. The Honorable George A. Drew, Premier and Minister of Education of the Province of Ontario, is honorary president. At the annual at-home of the society held at the University of Toronto on January 19, when Dr. Johns was inducted as president, Dr. Douglas gave an address on "Astronomy, Physics and Philosophy."

THE University of Oxford has conferred the title of professor on Dr. Ida Mann for as long as she remains Margaret Ogilvie's reader in ophthalmology and has provided a salary of £2,000 a year on condition that she give up private practice for profit. The university has collected £100,000 of the £250,000 required for research into fundamental problems affecting vision, with particular reference to biochemical problems.

DR. ISAIAH BOWMAN, president of the Johns Hopkins University, has been appointed a special adviser to the Secretary of State, Edward R. Stettinius, Jr., to act as consultant on matters of foreign policy.

DR. LAWRENCE W. SMITH, of the School of Medicine of Temple University, Philadelphia, has been acting as consultant on epidemic diseases to the Secretary of War.

DR. ROY K. MARSHALL has been appointed assistant director of the Franklin Institute in charge of astronomy, photography and seismology, and director of the Fels Planetarium of the institute, of which he has hitherto been assistant director. He succeeds Wagner Schlesinger, who will become director of the Adler Planetarium, Chicago.

T. L. YUAN, executive secretary of the Library Association of China, who has been sent to this country to develop cultural relations between the universities of the two nations, has announced the election of Professor Charles H. Brown, librarian of Iowa State College, as an honorary member of that association and chairman of the Committee on the Orient of the American Library Association.

DR. KENNETH G. KOHLSTAEDT has been appointed head of the Lilly Laboratory for Clinical Research at Indianapolis. He will continue the work in cardiovascular disease which has been underway for several years. Among those associated with him will be Dr. R. A. Shipley, of the School of Medicine of Western Reserve University.

DR. A. HALDANE GEE has been appointed director of the Development and Pilot Laboratories of William R. Warner and Company, Inc., to conduct the pilot plant operations necessary for smooth transition of new products from research to full production. Dr. Robert T. Conner, formerly senior research chemist in charge of control at the Central Research Laboratories of General Foods Corporation, has been appointed technical director. He will be responsible for the control of quality, correctness of formulae and label statements of all products manufactured by the firm and its subsidiaries.

DR. ENRIQUE KOPPISCH, professor of pathology and head of the department at the School of Tropical Medicine of the University of Puerto Rico, has leave of absence to enable him to act as consultant in the Army Medical Museum in Washington.

DR. GEORGE W. JEFFERS, professor of biology at the State Teachers College, Farmville, Va., will conduct for a year a survey of the fisheries resources of Chesapeake Bay. The study is financed by the General Education Board of the Rockefeller Foundation, and was initiated by the Chesapeake Bay Fisheries Commission, made up of representatives from Maryland and Virginia.

DR. ALDEN H. MILLER, associate professor of zoology at the University of California at Berkeley, will spend two months in Colombia, S. A., to obtain specimens of land birds and small mammals for the Museum of Vertebrate Zoology, of which he is the director.

THE Commonwealth Fund of New York City has made a grant of $32,600 to Dr. Enrique E. Ecker, professor of immunology at the Institute of Pathology of Western Reserve University, to continue his work for two more years on the "chemical factors involved in resistance to disease." This grant will enable him to add a physical chemist to his staff and to expand his work on protein fractions of the blood serum that have an important function in the defense of the body against infectious diseases.

THE twenty-first Ludvig Hektoen Lecture of the Frank Billings Foundation will be delivered on March 23 at the Palmer House, Chicago, by Dr. Joseph W. Beard, assistant professor of surgery at the School of Medicine of Duke University. The title of the lecture will be "The Ultracentrifugal, Chemical and Electron Micrographic Characters of Purified Animal Viruses."

PROFESSOR G. W. BEADLE, professor of biology at Stanford University, will deliver during January, February and March a Sigma Xi lecture at twenty-six colleges and universities. In addition he will speak before the St. Louis Symposium and will deliver the Harvey Lecture of the New York Academy of Medicine.

IN order "to cooperate to the fullest possible extent with the request of the Office of Defense Transportation and in the interest of the nation's war effort," the American Medical Association has cancelled its annual meeting, which was to have been held in Philadelphia from June 18 to 22.

Nature reports that the Division for Social and International Relations of Science of the British Association recently arranged a conference at the Royal Institution on "The Place of Science in Industry." It was opened by Sir Richard Gregory, president of the association. There were four sessions at which the chair was taken, respectively, by Ernest Bevin, Lord McGowan, Sir John Greenly and Lord Woolton. The subjects of the sessions were what industry owes to science, fundamental research in relation to industry, industrial research and development, and the future—what science might accomplish.

APPLICATIONS to the Committee for Research in Problems of Sex of the National Research Council for financial aid during the fiscal year beginning on July 1, in support of work on fundamental problems of sex and reproduction, should be received before April 1. They may be addressed to the chairman, Dr. Robert M. Yerkes, Yale School of Medicine, New

Haven 11, Conn. Although hormonal investigations continue to command the interest and support of the committee, preference, in accordance with current policy, will ordinarily be given to proposals for the investigation of neurological, psychobiological and behavioral problems of sex and reproduction.

THE Merit System Council of the State of West Virginia (212 Atlas Building, Charleston 1, W. Va.) announces unassembled examinations for higher positions in the West Virginia State Health Department. These include the position of director of communicable diseases with a salary of from $4,800 to $6,000, and of field clinician (tuberculosis), with a salary of from $3,960 to $5,160. There will be no state residence requirements for these examinations, but preference in making appointments may be given to West Virginia residents. Applications may be filed at any time at the office of the merit system supervisor, from whom further information can be obtained. New registers will be established as soon as a sufficient number of applications have been received to furnish adequate competition.

THE Medical School of the University of Minnesota will erect at a cost of two million dollars a twelve-story building as a memorial to the late Drs. Charles H. and William J. Mayo. The building will be situated at the center of the University Hospital Quadrangle and will form with the present buildings one medical center. These buildings include the existing Student Health Service, the obstetric unit and outpatient clinics, the William Henry Eustis Children's Hospital, the Elliot Memorial Hospital, the George Chase Christian Memorial Cancer Institute, the Todd Memorial Eye, Ear, Nose and Throat Hospital, a future hospital addition and a proposed building for the School of Public Health. All floors of the building from the basement to the fifth floor will connect with the present hospital buildings. A Mayo Memorial Fund has been established to which may be credited private and public donations and appropriations. Headquarters for the fund are at 1126 Northwestern Bank Building.

YALE UNIVERSITY has received a grant from the American Optical Company in support of research on ocular behavior in the general program of the Clinic of Child Development in the School of Medicine. These studies are part of a systematic investigation of the ontogenetic development of behavior in infants and young children. They are being conducted under the direction of Dr. Arnold Gesell in close association with the guidance nursery and the diagnostic service of the clinic.

DISCUSSION

THE AGE OF THE PUNJAB SALT SERIES

No geologist whose vision extends farther than his local horizon can but be interested in the classical sections and fossils of the Salt Range in northwestern India, nor need be reminded of their importance. And similarly there has been no question of Indian geology that has been more debated or that has been more baffling, especially in recent years, than the geological age of the Saline Series of the Punjab.

I have just received a paper,[1] published last September by a distinguished Indian paleobotanist that seems to afford rather convincing evidence on this subject, and since this paper is likely to be missed by numerous geologists, especially in the present abnormal times, it seems desirable to call especial attention to it.

The Saline Series lies beneath unmistakable Paleozoic, and the classic and not often questioned interpretation was that the Salt beds were of Cambrian or pre-Cambrian age, as set forth in Blanford's "Manual of the Geology of India," published in 1878, thus constituting the "oldest known salt beds" (Kayser, p. 76).

Koken and Noetling (1902–03) appear to have been the first to question this, and subsequently several others have taken up the Koken and Noetling views, explaining the observed stratigraphic succession as due to the Paleozoic having been overthrust on the Eocene by the so-called Nummulitic deformation.

It is no part of my purpose to give a detailed or documented account, and those interested can find suitable references in the published "Records of the Geological Survey of India." Professor Sahni's material consists of microscopic fragments, mostly vegetable but also including some insect remains. The former comprise such things as shreds of Conifer tracheids, plant hairs, tiny shreds of leaf cuticles, multiseriate pitted wood cells, etc. If this material was actually *in situ* there seems to be no question as to its post-Paleozoic age, although in all fairness it should be said that Sahni exhibits the proper scientific caution and is not in the least categorical, nor is it my purpose to do more than call attention to the first-hand work on the subject.

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[1] B. Sahni, *Proc. Natl. Acad. Sci. India*, 14: 49–66, 1944.

THE PEACH MOSAIC DISEASE[1]

FIELD experiments in 1942 and 1943 in the Western Slope region of Colorado produced evidence that the

[1] Scientific Series Paper No. 186, Colorado Agricultural Experiment Station, Fort Collins, Colo.

green peach aphid, *Myzus persicae* (Sulzer) could transmit the virus of peach mosaic disease. Carefully controlled experiments carried out in 1943 and 1944 under greenhouse conditions have confirmed the results obtained in the field and prove the ability of this insect to transmit the virus of peach mosaic.

Peach seedlings grown from Georgia native pits under insectproof cages in the greenhouse were used as test trees. These seedlings have never shown symptoms except when vegetatively inoculated.

Cultures of the green peach aphid were taken from peach trees growing in the orchard and maintained throughout the year on plantings of potatoes. Both viviparous apterous and alate forms were used after they had fed for varying periods on the flowers and foliage of diseased peach twigs. In transferring the insects, infested flowers and foliage were cut from a diseased twig and suspended in the top of the test seedling, to which the aphids migrated. Aphids were confined during the feeding periods on infected twigs and on test seedlings in closed glass chambers. The number of aphids and the length of time on the test tree have varied. Eighteen trees out of twenty-five tests have shown symptoms of peach mosaic. Check seedlings of the same age and grown under the same conditions have remained healthy. Under greenhouse conditions the symptoms have tended to be mild; consequently, each test has been followed through at least one period of dormancy and further verified by bark grafting into uninfected seedlings and into June budded Elberta trees. Typical symptoms were produced by these bark grafts. In one of the first cases of successful insect transmission under greenhouse conditions five bark grafts into healthy seedlings produced five typical cases of mosaic in a period of 20 days.

It is not known whether *Myzus persicae* is the only insect that spreads peach mosaic in Colorado. Several other insects more or less common in the peach orchards of the state have been tested, but failed to transmit the virus of this disease.

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ANAEROBIC RESPIRATION

THE expression "anaerobic respiration" appeared in an article recently wherein the apparent anaerobic metabolism of a slime mold was described. The article brought forth some kindly and paternal advice from younger physiological chemists, one of whom asked, "Don't you mean fermentation?" Another wrote: "The expression 'anaerobic respiration' is rather startling to a manometrician; even botanists are giving it up. I think it wisest to drop the term and speak of carbon dioxide evolution in all cases, and of fermentation or glycolysis where these apply." That anaerobic respiration should be referred to as fermentation is rather generally held by the new school of physiological chemists who classify organisms as (1) aerobes possessing only oxygen-consuming metabolic systems, (2) strict anaerobes possessing only anaerobic fermentative metabolic systems and (3) facultative organisms possessing both oxygen-consuming and fermentative systems. I accepted the above criticism without comment until there was added the remark that I "as a botanist might get away with the expression." Then I began to wonder whether botanists were "getting away with" a time-honored biological concept, or physiological chemists were "getting away with" a narrow chemical point of view.

What first impressed me as extraordinary was the fact that the broad biological view of respiration was being narrowed down by physiologists, whereas the concept of oxidation was being broadened by the chemists. Thus, although certain physiologists now insist that respiration must involve molecular oxygen, chemists say that oxidation need not involve oxygen at all.

The confusion has arisen because of a redefining of respiration by the new school of physiological chemists. Instead of viewing respiration as a concept, as a complex reaction in living matter whereby energy is liberated, without reference to oxygen or the lack of it, physiological chemists make their own definition, one restricted to a reaction involving molecular oxygen. The biological concept is not only the broader one, but it is the historical one.

Pedantic fealty to definitions pervades, and retards, all branches of thought. Definitions are a necessity. We need them as students in order to understand a new language, but the better we know the language the less need we have for definitions.

Let us accept, for a moment, the definition point of view and see whether or not respiration or fermentation has until now been defined on the basis of oxygen consumption. The biologist regards respiration as that reaction or series of reactions in living matter whereby energy is released for the maintenance of life. E. C. Miller[1] defines respiration as any reaction in which there is a liberation of stored energy in cells; if without oxygen it is anaerobic respiration. Lundegardh[2] views the matter in the broad biological sense when he states that the aerobic process predominates in natural life; anaerobic respiration is a relief when aerobic life is temporarily checked.

The concept "fermentation" was likewise not put on an oxygen or non-oxygen basis. None of the earlier definitions includes or excludes oxygen. Fur-

[1] E. C. Miller, *Plant Physiology*, 1931.
[2] H. Lundegardh, *Ann. Agr. College, Sweden*, 8: 233, 1940.

thermore, bacteriologists not only make common use of the expression "anaerobic respiration," but they speak of "acetic acid fermentation" in which free oxygen is involved.

Respiration may be defined as any oxidative process in living matter which releases energy. In this case we are forced to accept the chemists' definition of oxidation, namely, "The withdrawal of electrons from a substance, with or without the addition of oxygen, or the withdrawal of electrons, with or without the withdrawal of hydrogen or elements analogous to hydrogen." Thus, whether respiration is viewed in the broader sense of a biological concept, or the narrow sense of a specific chemical reaction, the end is the same, oxygen need not be involved.

I believe that I express the consensus of opinion when I say that plant physiologists do not think it necessary or wise to substitute the term fermentation for anaerobic respiration. I believe, also, that I express the point of view of the majority of medical physiologists when I say that respiration should be used as a general term for all biological, energy-yielding reactions. The bacteriologists are of the same opinion; they regard respiration as referring primarily to energy relations, and fermentation as indicative of end products formed and substrates acted upon.

Several changes could be made. The term respiration could be dropped and reference made only to energy exchange. Or, the expression "internal respiration" could replace "anaerobic respiration." Of all possible changes, the least scientific is the substitution of fermentation for anaerobic respiration. But why make any change? Why not broaden the meaning of respiration, just as the chemists did that of oxidation when they found the need for doing so?

There is no objection to retaining fermentation to indicate certain anaerobic reactions, but when these reactions are substitutes for energy-yielding aerobic processes, they become anaerobic forms of respiration.

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BASIS FOR SCIENTIFIC TERMINOLOGY AND CLASSIFICATION

THE formulation of the following remarks was catalyzed by the article by Dr. Fox on "Biochromes," appearing in SCIENCE for November 24, 1944. I wish to make it quite clear at the outset that the following matter is intended as constructive criticism of principle designed for stimulation of discussion; it is not intended as an individual criticism of the specific content of the above article.

It is proposed by Dr. Fox that a certain group of substances be designated by a certain label on the basis of two facts—(1) their occurrence in living matter and (2) their possession of color, *i.e.*, selective absorption of parts of the visible spectrum. Certainly the name selected (biochromes) is well chosen for this particular purpose. Let us examine, however, the basic principle underlying the "excuse" for increasing the technical vocabulary. The mere existence of a certain group of substances only in living matter, as far as we know to-day, seems hardly enough of a justification for setting them apart under a new class-name; the possession of color is even less of a reason for so doing. The entire problem of color and light absorption is too large a subject for an offhand discussion; however, setting apart a group of substances merely because their selective absorption happens to fall into that region of the spectrum which is perceptible to the human eye and without apparent consideration to their structure and function types seems to be a fallacy. This is especially true when one considers that an increasingly greater part of our observations of matter is being done with the aid of the extra-visible regions of the spectrum, *i.e.*, photographic and instrumental observation and recording of ultra-violet and infra-red regions. If we continue to succumb to the temptation of designating and classifying the world around us merely on the basis of our five human senses, the systematization of science will be in a very sorry state indeed. Consider for a moment the possible appearance of the "Beilstein" based on this theory. The result makes me shudder.

The whole matter can be considered logically only if one considers the principles underlying scientific terminology and vocabulary. It is readily seen, I believe, that the classificational function of any science (referring, of course, only to the "exact" sciences) is a function subordinate to the investigational and creative function. The former can be held to be no more than a useful or usable tool for the latter. It is difficult to imagine the circumstances under which the former function can, per se, cause any significant advance of our knowledge of the world around us. It can be hardly denied that the latter statement covers the true aim of any scientific pursuit. Granted this thesis, it is readily seen that the classification and nomenclature must be so designed as to be truly useful, simple and durable. Much can be said about the first two conditions. I prefer to stress the last one. In the past century there have been all too many occasions for complete overhauling of classification and designation systems in almost all branches of science. Regrettably, in some branches it has not been done. In others, the changes were frequently made only to require revisions almost upon birth. The main reason for this has been the rather

short-sighted attitude in the original nomenclature; too much stress was laid on the obvious, or shall I say directly perceptible, differences in form and behavior. As the fundamental reasons for specific forms and forces of the material world began to emerge, the older systems of nomenclature began to lose their usefulness in the sense of being utilitarian tools. A bit more of deliberation and less haste might well have laid a foundation for truly comprehensive schemes, which would have allowed for future extension without fundamental revisions for relatively long periods of time. I fully realize that in the early pioneering days of many of the physical sciences in the past century a foresight of quality able to perceive even a fraction of what was to come must be merely wishful thinking. However, at the present time we have at our command vast amounts of information from which we are beginning to untangle a much more fundamental picture of the physical world than appeared possible not so very long ago. We are on the borderline of more and more marvelous revelations unpredictable as yet, but we do have at least a crude pattern of what is around us. On the basis of the information already at hand a concerted effort should be made to effect, over the period of a reasonable number of years, a thorough overhauling of the classification and nomenclature systems of the physical sciences to bring them into closer correlation with each other and to use much more general bases for such a system than has been the practice in the past.

The reason for my feeling so strongly on this matter can be explained rather briefly. It deals primarily with the nature of the scientific education and training we give to our students at the various levels of our educational systems. Consider what a student sees when he opens a brand-new text on any given branch of science to which he eventually comes in the school curriculum. Almost universally the first paragraph states, in one form or another, that the "science of ——— deals with ———," followed by a more or less long list of narrowly defined set of terms used. Relatively few texts admit that several other sciences have contributed and are contributing to the advancement of the particular branch in question. More frequent is the statement that for the proper understanding of the course the student must have had so many "years" of such-and-such sciences. The neophyte is thus rigidly channelled in his manner of thinking at the outset. No wonder that, after several years of training, his mind automatically selects the "physics" way of thinking when he walks into the physics classroom, only to switch to "chemistry" way when he enters the chemical laboratory, etc. Only the exceptionally perceptive students begin to grasp the true interrelation of all scientific bases during their school training years. The majority begin to get the glimmering of this long after they begin their more or less gainful occupation; all too frequently this happens much too late to do them any good. On many occasions I have been on the sidelines of an argument over a problem by physicists and chemists; much heat is frequently generated unnecessarily merely because of lack of mutual understanding at the base.

It is true that generally the scientific curricula call for a fairly diversified selection of courses. However, all too infrequently are there courses available for correlation of the points of view and techniques of the various sciences; when these are available, they are usually at the graduate level and not at an earlier level where they would be of more fundamental good. Certainly it is high time to drop the still-used definitions of, at least, chemistry and physics (those referring to "physical changes" and "chemical changes" and to "changes in form" and "changes in nature" of things). According to these older definitions the workers with the elementary particles of matter should be definitely classified as chemists, rather than physicists, as they are to-day. The dividing line between these two sciences is an outmoded illusion to-day. Similar division and partition lines between other physical sciences are no less tenuous. Isn't it time to realize this fact?

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SCIENTIFIC BOOKS

FLIGHT IN AMERICA

The First Century of Flight in America. By JEREMIAH MILBANK, JR. 248 pp. Illustrated. Princeton University Press. 1943. $2.75.

THIS is a very good book and it certainly is captivating, once one begins reading it. The title, however, contains two restrictions which may make some reader reluctant to start reading the book at all. Why restrict the subject to the first century, when obviously the last forty years have added so much to our knowledge of flying? Why restrict the subject to America when Europe has done so much for the advancement of the science of flying? Reading the book gives the answer to these two questions.

By restricting his subject to this hemisphere, although he obviously can not stick too closely to this rule, the author cuts off some technical details which may not interest the average reader as much as the palpitating tale of flight progress in this country. By

cutting off the last forty years of flight, the author makes it possible to present in a single 250-page book a rather complete story of the first and second stages of flying, leaving off the third, which is well known to most of us. What gives a dramatic touch to this work is the fact that the author presents a complete cycle, a cycle going from dawn to dawn. The book starts when the echoes of a new discovery reach the American shores. A new light is coming from the East and the Americans are prompt to discover the tremendous possibilities of what they hear and what is just starting to be shown in the Western Hemisphere. When the first great free balloon floats over our continent, the people see endless possibilities for the future. An ocean which took weeks or months to cross will soon be crossed in hours. Gigantic balloons or grotesque assemblies of balloons are put on paper and one marvels at the endless possibilities of the creations of fantasy. That is the bright morning. During the noon hours a dozen of professionals make money, exhibiting their art from city to city, from town to town. They still talk about crossing the Atlantic and take patents on fantastic inventions. That is their noon hour, but soon some realistic newspapers begin asking what it is all about. What has the free balloon brought for trade and commerce? What are the promises it has kept? It has made people "air-minded." It has helped to understand the atmosphere. It has posed important physiological problems, but it has not added a bit to general prosperity. Resentment grows. The inventors answer with more fantastic claims. That is the dark age of the cycle. Then, at the end of the century, new hope appears. An American shows a little one-man dirigible with which he can fly around at will—inside a theater. He demonstrates his invention in many cities and news comes from abroad of larger dirigibles which fly in the open, even if there is a little wind. At the very turn of the century the Brazilian, Santos Dumont, flies his gasoline-powered dirigible around the Eiffel Tower; and the German, Lillienthal, glides down from little mountains piloting his motorless plane apparently at will like a bird. One sees the dawn of a new era. The author does not mention the Wright brothers, but the reader knows they are at work in their little secret shop and soon the sun will rise over Kitty Hawk and the first man-carrying, machine-powered airplane is going to fly. The cycle is closed, and that is as far as the author brings us. By means of two artificial looking restrictions the author has carved out a field small enough to be presented in one book and comprehensive enough to give a fine picture of the beginning of aviation.

The book is nicely printed. On the cover we see a golden free balloon on a silver gray background. The picture is an artistic interpretation of the real thing, and the features, as far as given by the artist, are correct to the last detail.

Unless, however, we are looking only for the literary value of the book we are disappointed by the fly-leaf. The free balloon picture given here is artistic, perhaps? Probably not. Art does not require the negation of science and the perspective, certainly a part of art, is all wrong. Technically, too, this balloon is incomprehensible. The net reaches lower than the top of the suspension ropes which obviously should lead to the bottom of the net and not stop in mid-air above the lower edge of the net. This is, of course, a detail, but it makes us suspect that the author is not interested in the technique of the construction of the free balloon. For the first half of the book scarcely a single engineering question is raised and yet flying is surely an engineering problem. In the introduction the author expresses his intention to treat problems of technology only as far as they apply to the basic features of aircraft. He mentions, indeed, very few of these features and no attempt is made to explain the importance of the appendix. The art of ballooning is not described. The author's statement that a balloon entering cold air will need reduction of weight in order to maintain altitude is in opposition to the facts and shows definitively that the author is not at all interested in the fundamental problems of aerostatics. The book would gain immeasurably if the elements of aerostatics and engineering were given more attention.

In his description of the flights made in 1783, we would like the author to give more credit to the Montgolfier brothers. They not only produced the first paper bag to rise within a room after having been held over an open fire, but they made also the first large-scale experiment on June 5, 1783, with their 105-foot circumference hot-air balloon and again it was a Montgolfière (hot-air free balloon) which first brought men (Pilâtre de Rozier and the Marquis d'Arlandes) in the air for a 9,000-yard journey. This was November 21, ten days before the hydrogen balloon flight by Charles. The balloon which Charles had launched on August 27 was not manned, and the Montgolfier brothers had already made their initial experiment of June 5 with their large unmanned balloon. Another point of history seems doubtful: Milbank relates that Muzio Muzzi exhibited his model of a flying machine to "the Royal Family" at Florence in the year, 1839, when, as a matter of fact, Florence became capital of the Sardinian (later Italian) kingdom only after the last grand duke Leopold had been expelled in 1859.

One thing which makes this book agreeable to read in contradistinction to many other popular engineering books is the perfect mastery of grammar. Not a

single badly constructed sentence is noticeable. Unfortunately, the same can not be said about the author's use of specific words. He speaks about easterly wind currents when he means a westerly wind. Winds, like people, are named after the country or region from which they come and not after the region where they are going. One should not speak about foot pedals any more than one speaks about hand handles. Discovery means something else than invention, although both terms are frequently confused. Last, not least, according to the Oxford dictionary, the one who makes an exhibit (or demonstrates his merchandise) should be called an exhibitor. The word used by Milbank has a rather bad connotation and should not be used about balloons. The illustrations of the book are very interesting and very beautifully printed. This is quite an achievement, since most of them are taken from old books which are always difficult to reproduce. The pictures are printed on special paper. This has restricted their introduction into the book to every sixteenth page, sometimes far away from the text to which they belong. It would therefore be desirable if in a future edition a reference to the text were given with the pictures and/or a reference to the pictures were given in the text.

It would be unfair for the reviewer to pick on certain omissions which one might find in the book. The author is still gathering material and in the introduction he himself hints at the need of a new edition and we hope very much that Milbank will one day find the time to produce a new and enlarged edition. This will be very welcome to all who are interested in the conquest of the atmosphere. The author has done an admirable work in collecting and coordinating material very difficult to get and we all owe him a cordial welcome and sincere thanks.

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PROTEIN CHEMISTRY

Advances in Protein Chemistry. Edited by M. L. ANSON and J. T. EDSALL. Volume I. xi + 341 pp. New York: Academic Press. 1944. $5.50.

THE intimate participation of proteins in the activity of living matter makes the acquisition of knowledge concerning their chemical structure and properties a necessary prerequisite for the understanding of the chemical basis of biological phenomena. Unfortunately, in attempting to secure this knowledge, the protein chemist has been confronted by formidable experimental difficulties. The fact that proteins represent organic molecules of such size and such complexity as to the arrangement of the amino acid residues, precludes the application of most of the known techniques developed in organic chemistry for the elucidation of the chemical structure of simpler molecules. For this reason, the ingenuity of the experimenter has been put to the test most severely to find new lines of attack on the protein problem. These efforts have resulted, in recent years, in the application, to the study of proteins, of a variety of physical techniques such as electrophoresis, sedimentation and x-ray analysis. Notable progress also has been made in the development of methods for the determination of the amino acid composition of proteins. While these new lines of attack have not yielded a solution of the fundamental questions of protein structure, much valuable knowledge has been gained and the way has been prepared for future progress.

In inaugurating the series of volumes on "Advances in Protein Chemistry," Anson and Edsall have set themselves the laudable aim of making available to the chemist and biologist the data on proteins obtained by means of the newer experimental techniques. They also intend to provide "the opportunity to workers in special subjects to present their views in more organized form than is possible in the regular journals, and also to express their personal judgment on problems which are unsettled." The editors express the hope that "as the reviews accumulate, they will provide a useful and comprehensive picture of the changing and growing field of protein chemistry and a stimulus to its further development."

In the selection of papers for the first volume of the series, special emphasis was placed on the role of proteins as components of biological systems. The volume contains eight review articles: "Lipoproteins," by Erwin Chargaff; "Structural Proteins of Cells and Tissues," by Francis O. Schmitt; "Some Contributions of Immunology to the Study of Proteins," by Henry P. Treffers; "The Interaction between the Alkali Earth Cations, Particularly Calcium, and Proteins," by David M. Greenberg; "The Purification and Properties of Certain Protein Hormones," by Bacon F. Chow; "Soybean Protein in Human Nutrition," by Donald S. Payne and L. S. Stuart; "Nucleoproteins," by Jesse P. Greenstein; and "The Proteins of Skeletal Muscle," by Kenneth Bailey.

These contributions are both factual and critical in character and can not fail to stimulate thought and discussion. The comprehensive bibliographies which are provided at the close of each article are most valuable. Indeed, the high caliber of the papers in this first volume of "Advances in Protein Chemistry" gives promise that the series will become a useful addition to the library of everyone interested in the nature and function of proteins.

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SPECIAL ARTICLES

THE DEFECT IN UTILIZATION OF TOCOPHEROL IN PROGRESSIVE MUSCULAR DYSTROPHY[1, 2, 3]

EXPERIMENTAL observations on 15 patients with progressive muscular dystrophy have indicated that this condition closely resembles the muscular dystrophy induced in animals by deprivation of tocopherol. In experimental muscular dystrophy in animals, tocopherol given by mouth promptly reduces the creatinuria and restores muscular function, whereas the parenteral administration of the vitamin (as the free substance) is practically without effect, suggesting that tocopherol undergoes some necessary change in the gastrointestinal tract. Tocopherol (either the free substance or the acetate, phosphate and succinate esters) in oral doses of from 1 to 5 g was without effect on the creatinuria of any of the 15 patients except one in whom the dystrophic process was of unusually slow progression. However, tocopherol that had been incubated in the stomach of a normal man lowered the creatine output of about one half of the subjects. The biologically active substance could not be removed from the gastric expression by extraction with ethyl ether. The *in vitro* incubation of the vitamin with an extract of hog stomach and duodenum rendered tocopherol effective in reducing creatinuria in patients with slowly progressing symptoms when propylene glycol was added to the incubation mixture, but no effect on creatinuria was observed when choline or ethanolamine was substituted for the propylene glycol. In one mild case tocopherol given together with the extract of hog stomach and duodenum lowered the creatine output.

Cold-pressed wheat-germ oil produced no demonstrable change in the excretion of creatine, but wheat-germ oil obtained by extraction with warm ethylene dichloride reduced the creatinuria of 4 patients. Similar effects were observed in 2 other subjects with Graves' disease. The ethylene dichloride extract of ether-defatted wheat germ[4] yielded a residue that was about 15 times as effective as the extracted oil of whole wheat germ.

Tocopherol treated by the following procedures was effective in about 60 per cent. of the patients, the effect being definite in mild cases and minimal or absent in severe cases: (1) refluxing on the steam bath with ethylene dichloride, ethylene dibromide, ethylene chlorohydrin or ethylene bromohydrin with constant stirring in an atmosphere of nitrogen; (2) refluxing with ethylene dichloride in the presence of ascorbic acid as an antioxidant; (3) heating with ethylene oxide in the autoclave at 200° in an atmosphere of nitrogen at a pressure of 2,000 pounds. The probability that the biologically active substance was a condensation product of ethylene glycol and tocopherol in ether linkage was suggested by the previous work of Renshaw,[5] John,[6] Fernholz,[7] Marle[8] and Smith[9] who had prepared the ethylene glycol and other ethers of hydroquinone, duroquinone and phenol by methods similar to those used in the present investigation. The active principle was readily soluble in ether and only slightly soluble in water, although the product formed in the *in vivo* incubation experiments in the normal man was readily soluble in water.

On the basis of these findings and of observations made by numerous workers in experimental muscular dystrophy induced by tocopherol deprivation, it was postulated that the substance with which tocopherol forms a condensation product in the body should (1) be a glycol which could form an ether linkage with the free hydroxyl group of tocopherol, (2) contain several more hydroxyl groups than ethylene glycol for the final condensation product to be readily soluble in water, (3) be one that enters into reaction in the absorption of fatty acids, since the antagonistic effects of unsaturated fats on tocopherol appear not to be satisfactorily explained by the oxidative destruction of the vitamin and (4) be more easily available in the intestinal tract than are the short chain glycols. Moreover, a substance apparently so essential for the utilization of tocopherol would likely be available in the natural sources of tocopherol, for example, wheat germ.

One substance that seemed to satisfy these postulated requirements is inositol. Therefore, the following investigations were carried out: Equimolecular amounts of benzene hexachloride and alpha tocopherol in absolute alcohol containing KOH were refluxed on the steam bath with constant stirring in an atmosphere of nitrogen. The condensation product was readily soluble in water, and could be removed from ether solutions by extraction with water. Micro-

[1] Preliminary report.

[2] From the Departments of Medicine and Psychiatry, Cornell University Medical College, and the Russell Sage Institute of Pathology in Affiliation with The New York Hospital, New York.

[3] Aided by grants from the Nutrition Foundation, Inc., and the National Foundation for Infantile Paralysis, Inc.

[4] A. T. Milhorat, F. C. Weber and V. Toscani, *Proc. Soc. Exp. Biol. and Med.*, 43: 470, 1940; A. T. Milhorat, V. Toscani and W. E. Bartels, *Proc. Soc. Exp. Biol. and Med.* (in press).

[5] R. R. Renshaw and C. Y. Hopkins, *Jour. Am. Chem. Soc.*, 55: 1524, 1933.

[6] W. John, E. Dietzel and P. Gunther, *Zeits. Physiol. Chemie*, 252: 208, 1938.

[7] E. Fernholz and J. Finkelstein, *Jour. Am. Chem. Soc.*, 60: 2402, 1938.

[8] E. R. Marle, *Jour. Chem. Soc.*, 101: 305, 1912.

[9] R. A. Smith, *Jour. Am. Chem. Soc.*, 62: 994, 1940.

analyses, while not conclusive due to difficulty in removing the salts, suggested that the substance was a monoether of inositol and tocopherol. The material was stable in alkaline solution, but an acidity of pH 2.0 or lower split the substance and destroyed the activity on creatinuria. Direct comparisons can not be made but in rough figures, the substance was 2,500 times as effective as wheat germ oil obtained by ethylene dichloride extraction and 40,000 times as effective as wheat germ itself.

In one patient with muscular dystrophy of moderate severity, a single dose of 60 mg given with alkali reduced the creatinuria appreciably in 24 hours, and to one half the control level in 3 days. The excretion of creatine continued at this low level for a period of 8 days and then gradually rose to its previous control level. However, the effect was smaller and of shorter duration in 4 other patients with rapidly progressive symptoms. In one of these subjects a single dose of 95 mg lowered the creatine output only 14 per cent. for 3 days.

Although tocopherol or inositol given alone was without effect on creatinuria, definite effects were observed in 5 of 7 patients when these two substances were given together in equimolecular amounts for 1 or 2 days. The dosage of the mixture required to produce effects on creatinuria appeared to be proportional to the rate of progression of the dystrophic process. In general, the mixture was from 1/8 to 1/30 as effective as the condensation product. Incubation with an extract of hog stomach and duodenum increased the effect of the mixture of tocopherol and inositol on creatinuria; this effect was greater than that of equivalent amounts of tocopherol and propylene glycol similarly treated.

The observations suggest that tocopherol forms a condensation product with inositol in the gastrointestinal tract (tocopherol-inositol ether) and that the inherited defect in muscular dystrophy is a deficiency in this reaction of condensation. The degree of this deficiency appears to determine the rapidity with which muscular disability progresses. Patients in whom the disease process is mild can synthesize sufficient amounts of the condensation product when large amounts of both tocopherol and inositol are given together, but those in whom the disease is more rapidly progressive will probably require the condensation product itself.

A complete report with details of data and acknowledgments is in preparation. Investigations on the effect of prolonged administration of this product on clinical status in a large series of patients are in progress.

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MITOSIS IN REGENERATING LIVER[1]

IN one-month-old rats, the rate of mitosis is at a maximum 24 hours after partial hepatectomy.[2] The experiments described here were designed to determine whether this maximum rate could be further increased. All substances to be tested were administered intravenously 24 hours postoperatively and the remaining liver removed for assay 3 hours later. In each experiment 5 to 10 animals were given the test substance, while an equal number of controls received normal saline. Nuclei were isolated by the citric acid method and counts made with a hemocytometer.[3] For simplicity, only nuclei in metaphase and anaphase were classified as being in mitosis. Variations of 10 per cent. in the mitotic count were within the limits of error of the method and were therefore not considered significant.

Of 9 preparations of chromatin[4] from rat liver which were tested, 7 produced an increase in mitosis of 25 to 100 per cent., one showed an increase of only 12 per cent., while another gave a decrease of 13 per cent. Chromatin from beef liver gave an increase of 70 per cent., and of two preparations of rabbit liver chromatin tested, one increased the mitotic rate by 55 per cent., the other 290 per cent. Several preparations of chromatin made at room temperature all had no effect on mitosis.

When isolated chromatin was extracted with 1 M NaCl a considerable portion remained insoluble. Four preparations of this insoluble fraction were tested and none found to produce a significant change in the rate of mitosis. Of seven preparations of the soluble fraction, two gave increases of only 19 to 22 per cent., while the remainder showed increases of 60 to 140 per cent. When stored at 5 to 10° C, two of the active soluble fractions lost their stimulating effect in 2 to 4 days. One preparation of fat-free chromatin produced a 200 per cent. increase in mitotic rate.

The following substances were found to have either no effect or a negative one: Various crude fractions from the liver other than chromatin, casein digests (Stearn's Amino Acids, Amigen), l-cysteine, dl-methionine, insulin, adenosine triphosphate, adenylic acid, lecithin, biotin, lipid from chromatin.

The increase in the number of nuclei in metaphase and anaphase is not in itself sufficient evidence for an increase in the rate of mitosis, for such a result may be obtained if mitosis is arrested at either of these stages. Counts were therefore made of the relative

[1] The work described in this paper was done under a contract recommended by the Committee on Medical Research between the Office of Scientific Research and Development and the University of California.

[2] A. Marshak and R. Byron, Jr., unpublished.

[3] A. Marshak, *Jour. Gen. Physiol.*, 25: 275–291, 1941.

[4] A. Claude and J. S. Potter, *Jour. Exp. Med.*, 77: 345–354, 1943.

frequency of nuclei in all stages of the mitotic cycle *i.e.*, resting stage, prophase, metaphase, anaphase and telophase. The proportion of nuclei in anaphase as compared to metaphase, and of both these stages to prophases in chromatin-tested animals was found to be the same as in the controls. It was concluded, therefore, that the observed increase in the frequency of metaphases and anaphases was due to a true increase in the rate of mitosis, and that the phase of the nuclear cycle in which the stimulation occurred was some portion of the resting stage.

To determine whether material from chromatin administered intravenously can become incorporated into the nuclei of the liver, chromatin was prepared from animals which had received P^{32} as Na_2HPO_4 and this injected into test rats 24 hours after partial hepatectomy. Related substances were similarly labeled, isolated and administered to the test animals. The livers were perfused and nuclei isolated 3 hours later. Table 1 shows the accumulation of P^{32} in the liver tissue

TABLE 1

P^{32} IN REGENERATING LIVERS THREE HOURS AFTER INTRAVENOUS INJECTION OF LABELLED SUBSTANCES

Material injected	Number of rats	P^{32}/gm liver as per cent. dose	Standard error of mean
1. Inorganic phosphate	84	4.52	0.083
2. Inorganic phosphate	10	4.36	0.084
3. Rat chromatin	19	26.30	0.670
4. Lipid (rat chromatin) ..	15	32.20	0.390
5. Fat free chromatin (rat)	5	7.10	0.480
6. Adenosine triphosphate .	7	4.43	0.320
7. Rabbit chromatin	8	23.10	0.200
8. Rabbit chromatin soluble in 1 M NaCl	8	16.20	0.470

from the various substances administered. There is a large accumulation from chromatin and from phospholipid which is undoubtedly due to the particulate nature of these materials. Table 2 gives the P^{32} con-

TABLE 2

P^{32} UPTAKE BY NUCLEI

Substance injected	Per cent. dose gm nuclei	Per cent. liver P^{32} in nuclei
Inorganic phosphate	1.54	2.1
Rat chromatin	5.08	1.2
Rabbit chromatin	5.06	1.3
Rabbit chromatin soluble in 1 M NaCl	4.23	1.6
Fat free chromatin (rat) .	5.45	4.6
Lipid (rat chromatin) ...	5.15	1.0

centration in the liver nuclei as per cent. injected dose per gram nuclei, and also the nuclear P^{32} as per cent. of the total liver P^{32}. From the latter figures it is clear that P^{32} from chromatin becomes incorporated into liver nuclei most rapidly from fat-free chromatin, least rapidly from lipid, with inorganic phosphate and crude chromatin in an intermediate position. The greater concentration of P^{32} in nuclei from animals receiving chromatin can not therefore be attributed to the mere accumulation of the particulate matter in the liver. The P^{32} from the chromatin evidently does not enter the cellar nucleus as phosphate ion but as a compound that may be of considerable size and complexity. The results are in some respects analogous to those of previous experiments which showed that the nucleoprotein of the living nucleus is in a state of dynamic equilibrium in which portions of it are constantly being removed and replaced.[3]

That the mitosis stimulating property of chromatin is not confined to the liver is indicated by preliminary experiments with standardized skin wounds of the rat. When a saline extract of fat free chromatin was applied locally, granulation tissue appeared 2 to 3 days earlier than in the controls, and also filled the wound area sooner. An excess of granulation tissue was not formed and there was no evidence of irritation or inflammation.

CONCLUSIONS

(1) Chromatin contains some factor which stimulates the rate of mitosis in the liver.

(2) Radioactive phosphorus becomes incorporated into nuclei of regenerating liver more rapidly from fat free chromatin than from phospholipid or inorganic phosphate.

(3) Since phosphorus containing compounds of considerable size and complexity may enter the cell and become built into the nucleus, the results suggest a possible means whereby controlled gene mutations may be produced if the gene be considered a nucleoprotein complex. The replacement of a portion of the nucleic acid or nucleotide by another of different structure may produce a change in function in the region of the chromosome so effected. Changes in type of pneumococcus[5] may be accounted for by such a process, rather than by alteration of the cytoplasm, as has been suggested.[6]

(4) Preliminary results indicate that a derivative of chromatin stimulates the rate of formation of granulation tissue in skin wounds.

Details of these experiments will be published elsewhere.

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SURVIVAL OF THE MAMMARY TUMOR MILK AGENT OF MICE[1, 2]

PREVIOUS observations demonstrated that the milk agent or inciter of mammary tumor in mice, normally

[5] O. T. Avery, C. M. MacLeod and M. McCarthy, *Jour. Exp. Med.*, 79: 137–157, 1944.

[6] T. H. Sonneborn, *Proc. Nat. Acad. Sci.*, 29: 338–343, 1943.

[1] Preliminary report.

transferred by nursing,[3] may be obtained from either spontaneous[4] or transplanted[5] mammary carcinoma or from lactating mammary tissue[6] or whole blood.[7] The active agent[8, 9] has also been found in cell-free filtrates. In this report preliminary data are presented from further studies on the characteristics of the active agent.

In these studies, tests for the presence of the tumor agent were conducted by the inoculation of female mice which had parents that did not transfer the influence in their milk but which had the inherited susceptibility for spontaneous mammary cancer. They were inoculated when they were 4 to 5 weeks of age. Following inoculation, they were permitted to breed regularly to insure an adequate hormonal stimulation. The mice were either ABC or ZBC animals. The ABC mice were produced as follows: females of the C57 black (B) and males of the A strain were mated, and the hybrid females produced were crossed to males of the A stock. The resulting back-cross progeny were called ABC animals. The ZBC mice, similarly, were back-cross animals to the Z or C3H stock following the mating of hybrid females produced by reciprocal matings between the descendants of the fostered mice of the A and Z or C3H stocks. To date, the incidence of mammary cancer in the controls, numbering several hundred, has been less than 1 per cent.

The first group of experiments to be reported was designed to produce additional evidence that the active milk agent may be carried in transplanted mammary cancer. The tumor used as the inoculum had developed in a female of the cancerous C3H stock and was designated as tumor No. 5663. The spontaneous tumor was tested to insure the presence of the agent. In the demonstration of the active agent, the tissue was first macerated and suspended in Ringer's solution (1:10 by volume). After the suspension was centrifuged, 0.5 ml of the supernatant liquid was injected intraperitoneally into each of 10 ABC[10] mice, of which 1 is still living and 8 (80 per cent.) have died with spontaneous mammary cancer. The balance of the supernatant liquid was filtered through a Berkefeld N candle. Eleven mice of the same stock were injected, also intraperitoneally, with 0.5 ml of the filtrate; 8 of these have developed mammary carcinoma.

Tumor No. 5663 was also inoculated into C3H mice and their hybrids which had not been exposed to the active milk agent. Transplants of the tumors were tested for the presence of the agent after the 1st and 10th transplant generations.

After one passage in mice, the tumors were macerated and suspended in Ringer's solution (1:4). The original suspension was injected subcutaneously into ABC mice in a dosage of 0.4 ml. Four of the 11 test animals have developed spontaneous mammary cancer and the others have survived 16 months free from tumors. A portion of the suspension was passed through a tested Berkefeld N filter and the filtrate was injected into 12 ABC mice in a dosage of 0.2 to 0.4 ml. Eight of the mice developed mammary cancer, while 4 failed to develop tumors.

Following the 10th serial passage of tumor No. 5663 in mice that do not carry the active milk agent, the tissue was suspended in distilled water (1:3) and 1 ml was given by mouth (tube-feeding) to each of 22 mice of the ZBC group. Of these, 8 are living at 12 months of age and 12 have died from spontaneous mammary cancer.

These results demonstrate that the mammary tumor milk agent persists in association with tumor transplants carried through 10 serial passages in mice that did not themselves carry the milk influence.[5] This indicates that the agent was continually produced within the transplant tumor cells. The findings seem to provide evidence for the theory, previously advanced,[11] that the active agent may play a role in the production of genetic mutations in transplantable tumors.

Tumor tissue prepared in the manner described above was also utilized in initial studies on chick embryos. Twenty-five hundredths of a milliliter of suspended tumor tissue (1:4 in Ringer's solution) of the first transplants of tumor No. 5663 was injected into the yolk sac of 5-day-old chick embryos. Twelve days later the yolks from 2 eggs that were negative grossly were pooled and 1 ml of the unfiltered yolk was injected intraperitoneally into mice of the ABC stock. Six mice were used, of which 3 developed mammary cancer. The others have developed no tumors during 17 months of observation. These results demonstrated that the milk influence survived 12 days in

[2] These studies were supported by grants from the Citizens Aid Society of Minneapolis, the University of Minnesota Graduate School Cancer Research Fund and the Jane Coffin Childs Memorial Fund for Medical Research.

[3] J. J. Bittner, SCIENCE, 84: 162, 1936.

[4] *Ibid.*, 93: 527, 1941.

[5] *Ibid.*, *Bull. Minn. Med. Found.*, 4: 94, 1944.

[6] *Ibid.*, *Proc. Soc. Exp. Biol. and Med.*, 45: 805, 1940.

[7] G. Woolley, L. W. Law and C. C. Little, *Cancer Res.*, 1: 955, 1941.

[8] J. J. Bittner, *Cancer Res.*, 2: 710, 1942.

[9] *Ibid.*, SCIENCE, 95: 462, 1942.

[10] Had living tumor cells been injected, the ABC mice, being the progeny of hybrids derived from mating mice of the A and C57 black stocks, should not have been susceptible to a C3H tumor. Moreover, transplanted tumors would have developed at the site of injection, intraperitoneally, within a few weeks.

[11] J. J. Bittner, *Am. Jour. Cancer*, 36: 44, 1939.

embryonated eggs, possibly in the presence of living tumor cells.

In a second group of experiments, further studies were made on the survival of the milk influence in embryonated eggs. These experiments were performed with a filtrate made from lactating mammary tissue of mice which carried the active agent. Lactating mammary tissue was macerated, suspended in broth (1:10) and centrifuged. The supernatant liquid was then filtered through a tested Berkefeld N filter, was tested for the presence of the active agent, and used to inoculate chick embryos. The test to ascertain whether the filtrate contained the active milk agent was performed by injecting 14 mice with 1 ml of the material intraperitoneally. Mammary tumors have resulted in 6 of the test mice, demonstrating the presence of the active agent. The remaining mice are alive and free from tumors at 13 months of age.

Eggs containing 5-day-old chick embryos were injected with 0.25 ml of the filtrate of mammary tissue. Two eggs were incubated for 1 hour, after which the yolks were collected and pooled, and 1 ml of the unfiltered yolk was injected intraperitoneally into each of 8 mice. Of these, 5 have developed spontaneous mammary tumors while the others are still under observation.

Other eggs of 5 days' embryonation that had received the filtrate were incubated for 12 days, after which time the yolks were pooled. Part of the yolk was centrifuged undiluted at low speed. Of 16 mice that received 1 ml of the unfiltered yolk intraperitoneally, 6 have developed mammary cancer while the others are still under observation. The balance of the yolk from eggs was extracted with Locke's solution (1:3) and centrifuged. The supernatant liquid was filtered through a Berkefeld V filter. One milliliter of the filtrate was injected intraperitoneally into each of 18 mice. Of these, 6 have shown spontaneous mammary tumors and the 12 others are living without growths at 13 months of age.

In the second group of experiments, a filtrate of mammary tissue, proved to contain the active tumor milk agent, did not produce grossly demonstrable tumors in 5-day embryonated eggs after 12 days of incubation. However, both unfiltered and filtered egg yolks, after 12 days' incubation, were found to contain the active mammary tumor milk agent. Therefore, our results, although adduced from a small number of mice, are interpreted to mean that the milk agent survived 12 days in the yolk sac in the absence of living mouse cells.

SUMMARY

The mammary tumor milk agent has been recovered from a transplanted mammary carcinoma that was carried for 10 passages in mice that did not themselves originally have the agent. It is possible that the agent, carried in the transplanted mammary tumor cells, may be responsible for the genetic mutations which have been detected in transplantable tumors.

Preliminary results show that the agent can be recovered from the yolk sac of chick embryos 12 days after the injection into eggs of either tumor suspensions or cell-free filtrates of tissues containing the active agent.

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SIMULATION OF PHOTOPERIODICITY BY THERMOPERIODICITY

A TOMATO plant is photoperiodically indifferent, since under properly controlled temperatures the daily length of illumination has practically no effect on its development. For best growth and fruit set, tomatoes have to be kept warm during day (26° C) and cool during night (15–18° C), which has been called thermoperiodicity.[1] The cool period for optimal development is only effective in darkness or in at least greatly reduced light, so that plants subjected to the proper temperature sequence in continuous light do not set fruit. Since no fruit set is possible above 22° and below 10° night temperature, tomatoes do not bear fruit in winter or spring nor during hot spells in summer, even though day temperatures are within the rather wide range of possible growth (15–35° C). It also has been established that each day sugar production by assimilation in tomato leaves continues only until early afternoon, when a maximum sugar content is reached.[2]

In Southern California winter and early spring night temperatures are usually below 10°, but the afternoon temperatures range between 15° and 20°, optimal for growth and fruit set. Therefore, if part of the afternoon were changed into a functional night, by daily covering tomatoes from 3:00 P.M. (war time) on, no loss of photosynthesis would occur, and an optimal night temperature would exist for a few hours.

To find out whether by these means tomato plants, growing outside, could be made to produce fruits out of season, some were planted in the field in the middle of November, 1943. Each afternoon at 3:00 P.M. half

[1] F. W. Went, *Am. Jour. Bot.*, 31: 135–150, 1944.
[2] F. W. Went, *Am. Jour. Bot.*, 31: in press.

of the plants were covered with tar paper, and uncovered next morning between 7:00 and 8:00 A.M. The first ripe fruits were harvested from the covered plants on April 1, 1944, and from then on they continued to produce. The non-covered plants did not produce fruits at all.

A more extensive experiment was started on March 17, 1944. Eight plots of 9′×9′ were each planted to tomatoes, beets and a few other vegetables. Two plots served as controls, and were not covered, but the other plots were covered at different hours in the afternoon. On July 6, after an exceptionally cool spring, the plants were harvested. Some of the results are shown in Table 1 (fresh weight in g. per plant).

TABLE 1

	Stone tomato		Earliana tomato		Beets	
	Whole plant	Fruit only	Whole plant	Fruit only	Whole plant	Root only
Control, not covered	304	10	420	37	126	61
Covered 2 P.M.–8 A.M.	433	0	545	7	62	9
Covered 3 P.M.–8 A.M.	1264	256	1054	272	122	37
Covered 4 P.M.–8 A.M.	719	101	677	121	149	67

From these data it appears that the development of tomato plants is not limited by photosynthesis, but that the use of the photosynthates is regulated by processes occurring in darkness at temperatures between 15° and 20°. This is not true for all plants, since the covering of beets produced only a slight and insignificant increase in weight. These experiments show that under certain conditions by the proper treatment the apparent efficiency of photosynthesis can be increased considerably in tomatoes.

The effects of the covering in these experiments were not due to photoperiodicity, but to thermoperiodicity.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

LOCATION OF THIAMIN AND RIBOFLAVIN IN WHEAT GRAINS

WE were interested in determining the distribution of thiamin in wheat grains in conjunction with analytical data on the thiamin content of various hybrid and inbred selections of wheat. We have developed a simple and rapid method that apparently gives results which are, in general, consistent with the milling data (see Bailey[1] and Andrews[2] for reviews) and with dissection studies previously reported.[3, 4]

Briefly, the technique is as follows: The wheat grains are dropped into molten paraffin. After the paraffin has hardened, the grain is cut on a rotary microtome. No attempt is made to cut entire sections; rather, 20-micron slices are cut from the grain until approximately the desired region is reached. Then one-micron slices are cut. This latter step gives a portion of a grain with a smooth surface. The cut surface of the grain is next treated with an alkaline solution of potassium ferricyanide similar to that used in oxidizing thiamin to thiochrome for fluorometric assay of extracts. The grains may be treated directly while still mounted in the paraffin, or the paraffin can be removed, using anhydrous benzene, if desired, and the grain mounted in modeling clay. The ferricyanide is applied by gently pressing the cut surface of the grain against a piece of Cellophane that has been soaked in the ferricyanide solution. Before the Cellophane is used, the excess moisture is blotted from it with filter paper.

The treated surface of the grain is then illuminated with a mercury vapor lamp using a suitable filter or filters. Various filters have been tried, but for thiochrome we have used mostly Corning filter no. 597. The fluorescence of the illuminated grain can be observed directly, with or without additional filters. We have found that viewing the fluorescence of the grain through a combination consisting of Corning filters nos. 338 and 428 gives the best results for thiochrome. Filters more specific for thiochrome fluorescence have been used. They show essentially the same picture. Cocarboxylase has been found to fluoresce the same way as thiamin after oxidation with the alkaline ferricyanide solution.

When treated grains are viewed using such combinations of filters, it appears that the cell walls of the aleurone layer fluoresce brightly. This is particularly true of the inner cell walls of the aleurone layer. Likewise, the scutellum fluoresces, but not as brightly as the epithelium and/or the adjacent crushed cells of the endosperm. The embryo, exclusive of the scutellum, shows little or no fluorescence. The endosperm shows some fluorescence, but this is apparently restricted to the walls of the endosperm cells. In fact, in all cases where cell structure can be made out, the fluorescence appears to be primarily in the cell walls. The untreated grains show no fluorescence except for a very weak fluorescence in the walls of the aleurone cells. In view of the previously reported distribution of

[1] C. H. Bailey, "Constituents of Wheat and Wheat Products," pp. 280–317, Reinhold, 1944.
[2] J. S. Andrews, *Food Industries*, 15: 78, August, 1943.
[3] J. J. C. Hinton, *Jour. Soc. Chem. Ind.*, 61: 143, 1942.
[4] A. H. Ward, *Chem. Ind.*, 62: 11, 1943.

thiamin in wheat grains,[1, 2, 3, 4] we believe that the fluorescence of treated grains indicates the distribution of thiamin and cocarboxylase in the grain.

By using another set of filters we have obtained fluorescence of a different color which we think is probably riboflavin or some product produced from it by the alkaline ferricyanide solution and, possibly, light. For this purpose we have used Corning filters nos. 511 and 038 on the light source and no. 349 for viewing the fluorescence. This fluorescence does not occur in untreated grains, but probably the concentrated alkali liberates the riboflavin from combination with protein and makes fluorescence possible. Possibly the riboflavin (or some nucleotide of riboflavin) is converted into a more strongly fluorescent compound by the treatemnt. The filter combination used shows the fluorescence of pure riboflavin, both before and after treatment similar to that given the grains. It does not show the fluorescence of oxidized, or unoxidized, thiamin or cocarboxylase. If our interpretation is correct, the results show that the embryonic plant, the scutellum and the aleurone layer are all about equal in riboflavin content. The outer bran layers appear to contain some riboflavin. The endosperm cells, apart from the aleurone cells, appear to contain little or no riboflavin.

Using the above techniques we have observed a fluorescence that indicates a relatively high concentration of thiamin (and/or cocarboxylase) and riboflavin in a region of the grain that hitherto has not been reported. At the base of the "crease" of a wheat grain is a layer one or more cells in thickness just inside the aleurone layer. The cells in this region resemble somewhat the aleurone cells and are continuous with them, but they are larger and more circular in outline. The walls of these cells apparently are rich in thiamin and riboflavin.

The treated grains may be kept for weeks without any apparent change in fluorescence. It is easy to make a photographic record of the fluorescence without using an excessively intense light source. For this purpose we have used a General Electric S–4 lamp, 100 watt, with a large, light-crown glass lens to concentrate the light and a photomicrographic camera with microtessar lenses.

We believe the method described above may prove useful in various studies on the role and distribution of these vitamins. For example, it may prove useful as an aid in the selection of wheat strains high in thiamin and riboflavin. The aim of such selection is twofold. One aim is to produce wheat which has a greater vitamin content. The other aim is to select wheat in which these vitamins are so distributed that they are included in the flour fractions by the ordinary milling procedures. Our method should greatly facilitate the selection of wheat strains which will meet this second aim. Furthermore, once a detailed knowledge is available concerning the distribution of thiamin and riboflavin in wheat, it may be possible to develop milling procedures which will produce flour rich in thiamin and riboflavin and still satisfactory in other ways.

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A CYLINDER GUIDE FOR USE IN PLATE ASSAY OF PENICILLIN

FOR several months in carrying out the cylinder plate method of assay of penicillin, this laboratory has been using a template or guide to facilitate placing the cylinders on the agar in the desired array. The interest in this device shown by visitors has prompted this brief description of its construction and the manner in which it is used.

The guide is made of Plexiglas but may be made of any similar clear plastic. In form it is simply a circular flanged lid through which six holes are drilled and is constructed to fit into a petri dish, the upper portion or cover of which is 100 mm in diameter and 20 mm high. Fig. 1 shows the specifications for the guide as used in this laboratory.

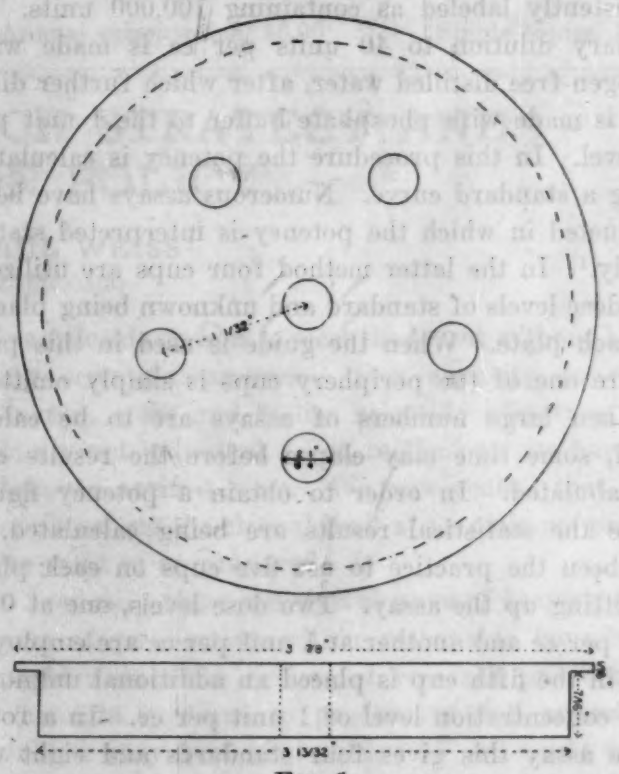

FIG. 1

The Plexiglas was obtained in the form of sheets one foot square and one-half inch thick. In a piece four inches square, cut from the large sheet, the centers for the six holes were marked off and drilled with a 3/16 inch drill. A flat board was placed in

the lathe and centered and to this board the Plexiglas was held by wood screws inserted through the holes previously bored. The Plexiglas was then turned on the lathe to the proper dimensions for the outside diameter and undercut and the holes enlarged to the dimensions given in Fig. 1.

While glass cylinders have been and are to some extent still used, most of the cylinders now being used in this laboratory are made of high-strength aluminum alloy tubing, No. 24ST, outside diameter 5/16 inch, wall thickness 0.035 inch, inside diameter 0.242 inch. This tubing is cut in 1 cm lengths, beveled at one end on the outside and the beveled end ground smooth. It has recently come to our attention that stainless steel cylinders are now available. These should prove to be more durable than aluminum.

The arrangement of the six apertures, which allow free passage of the cylinders and at the same time direct them to positions properly spaced, permits the latitude desired in setting up various forms of the assay. In one type of assay procedure used in this laboratory five cylinders are filled on each plate, using four plates for each assay. On each plate two cylinders are filled with standard penicillin diluted to one unit per cc with 1 per cent. phosphate buffer and to three cups is added the unknown solution diluted with phosphate buffer to approximately 1 unit per cc. The ampuls or vials submitted to this laboratory are quite consistently labeled as containing 100,000 units. A primary dilution to 40 units per cc is made with pyrogen-free distilled water, after which further dilution is made with phosphate buffer to the 1 unit per cc level. In this procedure the potency is calculated using a standard curve. Numerous assays have been conducted in which the potency is interpreted statistically.[1] In the latter method four cups are utilized, two dose levels of standard and unknown being placed on each plate. When the guide is used in this procedure one of the periphery cups is simply omitted.

When large numbers of assays are to be calculated, some time may elapse before the results can be tabulated. In order to obtain a potency figure while the statistical results are being calculated, it has been the practice to use five cups on each plate in setting up the assay. Two dose levels, one at 0.25 unit per cc and another at 1 unit per cc are employed and in the fifth cup is placed an additional unknown at a concentration level of 1 unit per cc. In a four-plate assay this gives four standards and eight unknowns. The potency can be calculated by using a standard curve and the value corrected, if necessary, when the result of the statistical analysis is available.

The center aperture is seldom used, but there are occasions which call for the assay of crude extracts, filtrates, etc., when a rough estimate of activity suffices. In such instances a one-cup assay may be run, permitting five assays on one plate with the standard in the center cup.

The use of the guide offers several advantages. It is simple to make, easy to clean and virtually indestructible. The cylinders fall the same distance onto the agar, insuring a good seal between the agar and all cups and providing for accurate and uniform spacing on all the plates. The guide should prove helpful for inexperienced operators who often have difficulty in evenly spacing the cylinders and who may drop them in such manner that they fail to remain upright. Assayists who have had nearly a year's experience in testing penicillin have found that the guide expedites placing the cylinders in position and that the operation requires less concentration on the part of the assayist.

SUMMARY

A guide or template is described which facilitates placing the cylinders on the agar surface in the plate assay of penicillin.

The general plan of conducting the assay is discussed and several advantages of the use of the guide are noted.

We wish to thank Mr. Albert G. Sterling, instrument maker, for fabricating the guide and the aluminum cylinders.

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[1] The statistical method used in calculating the potency and its error has been submitted for publication.

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